Volume 9, Issue 4, April – 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

Decentralized Mobility Solution: Blockchain Enhanced Peer-to-Peer Transportation

Empowering Urban Travel: Harnessing Blockchain for Decentralized Peer-to-Peer Mobility

Akash Mali[1]; Abhay Patil[2]; Rajat Mesharam[3]; Shreyash Bagade[4]; N.G.Bhojne[5] (Professor)
[1,2,3,4,5]Department of Computer Engineering, Sinhgad College of Engineering, Pune, Maharashtra, India

Abstract:- In today's rapidly evolving urban transportation landscape, the demand for efficient, decentralized mobility solutions is paramount. This research presents a comprehensive framework for a Blockchain-enhanced peer-to-peer transportation system. Drawing inspiration from various research papers, four pivotal modules are integrated to ensure a holistic and efficient approach to mobility. Firstly, the Blockchain Integration Module enables secure, transparent, and decentralized transactions, fostering trust and accountability. Secondly, the User Interface Module enhances user experience by providing an intuitive interface tailored to diverse urban settings. Thirdly, the Computational Module optimizes transportation aspects such as route planning and demand forecasting. Lastly, the Ride Allocation Module orchestrates efficient and equitable ride assignments based on user preferences and real-time conditions. Together, these modules offer a resilient and user-centric peer-to-peer transportation system, leveraging cutting-edge technologies and insights from existing studies to transform urban mobility.

Keywords:- *Blockchain, Decentralization, Ride Sharing, Peer-to-Peer.*

I. INTRODUCTION

The modern landscape of transportation has been transformed by the rapid rise of ride-sharing services, revolutionizing the way people commute and travel. These services facilitate individuals in optimizing the utilization of their personal vehicles, with ride-sharing drivers offering their rides to other passengers. The advantages of ride sharing extend not only to individuals but also benefit the broader community, encompassing heightened occupancy rates, shared trip expenses, expanded social networks, and reductions in both fuel consumption and pollution levels. Numerous companies, including Flinch, Uber Pool, and Ola, among others, offer online ride-sharing services worldwide, catering to the growing demand for efficient and sustainable transportation solutions.

The majority of existing ride-sharing applications such as Uber and Ola rely on centralized third-party systems to deliver ride-sharing services to their customers. However, a significant drawback of these traditional ride-sharing systems is the centralized storage of data, which poses the risk of system failure in the event of server malfunctions. Additionally, centralized systems are susceptible to a single point of corruption and failure, rendering them fragile compared to decentralized systems. This reliance on centralized infrastructure highlights the need for alternative approaches to ride-sharing services that offer increased resilience and reliability.

Blockchain based Peer-to-peer (P2P) technology represents a decentralized platform where individual peers can engage directly with each other, eliminating the need for third-party intervention in data transfer. This decentralized nature offers significant benefits, particularly in addressing security concerns within systems. With transactions occurring directly between peers, they are immune to control or manipulation by third-party clients or system developers. The integration of blockchain technology further enhances the deployment of P2P systems, ensuring decentralization and bolstering security against the rising threat of cyber-attacks. This strategic amalgamation of P2P and blockchain technologies addresses the pressing need for secure and resilient solutions in the face of escalating cyber threats in modern-day technology landscapes.

Decentralized ridesharing applications offer passengers the opportunity to gain insights into the inner workings of a ride-sharing business, facilitated by blockchain technology's inherent accountability features. Through the utilization of smart contracts, stakeholders can leverage blockchain-enabled peer-to-peer car rentals, ensuring transactions occur solely between the two parties directly involved and meet pre-established criteria. This approach ensures consistent pricing, fosters trust, and enhances transparency within the system. The integration of blockchain technology in decentralized ridesharing platforms not only facilitates efficient operations but also instils confidence among users through its transparent and accountable framework.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

II. LITERATURE REVIEW

- *Ride-Sharing Services: From Centralization to Decentralization.*

After conducting a thorough search across databases such as Google Scholar, Scopus, and ACM Digital Library, the author identified scholarly papers and publications pertaining to ride-sharing services and blockchain technology. The review process focused on extracting key findings and insights from the selected papers, with particular attention paid to those addressing challenges and opportunities of blockchain technology in ride-sharing services. Additionally, the author delved into papers discussing existing blockchain-based ride-sharing systems, design considerations for implementing such systems, and future research directions in this domain. This comprehensive review aimed to gather valuable insights into the intersection of ride-sharing services and blockchain technology, shedding light on potential solutions, innovative approaches, and avenues for further exploration in the field.

- *Reliability Analysis of Centralized Versus Decentralized Zoning Strategies for Paratransit Services.*

A simulation-based methodology to assess the reliability of various zoning strategies within a paratransit system. Utilizing a simulation model specifically designed for this purpose, they simulated the operation of the paratransit system under different zoning strategies across varying conditions. Through this simulation approach, they were able to evaluate the on-time performance of the paratransit system under each zoning strategy. By systematically comparing the performance outcomes generated by the simulation model, the researchers aimed to gain insights into the effectiveness and reliability of different zoning strategies in meeting the demands of the paratransit system.

- *Autorickshaw in Indian Cities, Public Perception and Operational Realities.*

They employed a mixed-methods approach to investigate public perception and operational realities related to autorickshaws. To explore public perception, a survey was conducted targeting autorickshaw users to assess their attitudes and opinions towards this mode of transportation. Additionally, interviews were conducted with autorickshaw drivers to gather insights into their firsthand experiences and the challenges they face in their profession. Alongside these qualitative methods, quantitative data on autorickshaws, such as statistics on them. Met

- *Research on Blockchain Technology: Urban Intelligent Transportation Systems in Developing Countries*

Delving into the realm of blockchain, proposed blockchain-based Urban Intelligent Transportation Systems (UITS) framework, which boasts several advantages over traditional UITS systems. Firstly, it offers enhanced decentralization and security by storing data on a blockchain network rather than a centralized server. Secondly, it ensures greater transparency and auditability, with all transactions being meticulously recorded on the blockchain. Thirdly, it exhibits improved efficiency and scalability, as blockchain technology adeptly manages large volumes of data without compromising performance. The envisaged framework holds immense potential to transform UITS in developing nations, rendering it more efficient, secure, and transparent. Additionally, it stands to positively impact traffic flow, alleviate congestion, and bolster road safety measures.

- *Blockchain-Based Ride-Sharing System with Accurate Matching and Privacy-Preservation*

The proposed blockchain-based ride-sharing system represents a groundbreaking opportunity for the ride-sharing sector. Its decentralized architecture and implementation of spatial cloaking technology are positioned to address critical issues related to precise matching and privacy protection. This innovative strategy is expected to improve the security, transparency, and privacy of ride-sharing transactions, benefiting both passengers and drivers. By harnessing blockchain technology and spatial cloaking, the envisioned system has the capacity to transform the ride-sharing industry, introducing a new era characterized by trust, efficiency, and confidentiality in transportation services.

III. METHODOLOGY

Blockchain-enhanced peer-to-peer transportation system Define the four pivotal modules (Blockchain Integration, User Interface, Computational, and Ride Allocation) and outline their functionalities, interactions, and dependencies within the system.

A. Software used.

The proposed system consists of two main software components: Blockchain development and Website development. Below is the inventory of software tools, libraries, dependencies, and APIs utilized in the development of the proposed system:

- *Visual Studio Code:*

Visual Studio is Web Development IDE and, in this project, it is used for developing Web applications.

- *Ganache:*

Ganache is a software that hosts a personal Ethereum based blockchain.

- *Node.js:*

Node.js allows to run JavaScript code on the server-side, enabling the development of scalable and high-performance web applications.

- *Next.js:*

Next.js is open-source framework for building React-based web applications, particularly for server-rendered and statically generated websites. It is often used for creating dynamic, high-performance, and SEO-friendly web applications with React.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

➢ *Typescript:*

TypeScript is an open-source programming language developed and maintained by Microsoft. It is a superset of JavaScript, meaning that any valid JavaScript code is also valid TypeScript code. However, TypeScript extends JavaScript by adding static typing, interfaces, and other features that make it more powerful and easier to maintain for large-scale applications.

➢ *Mapbox.io:*

Map box is a platform that provides developers with tools and services for building custom mapping and location-based applications.

B. Architecture Diagram

Architecture diagram explains the system architecture.

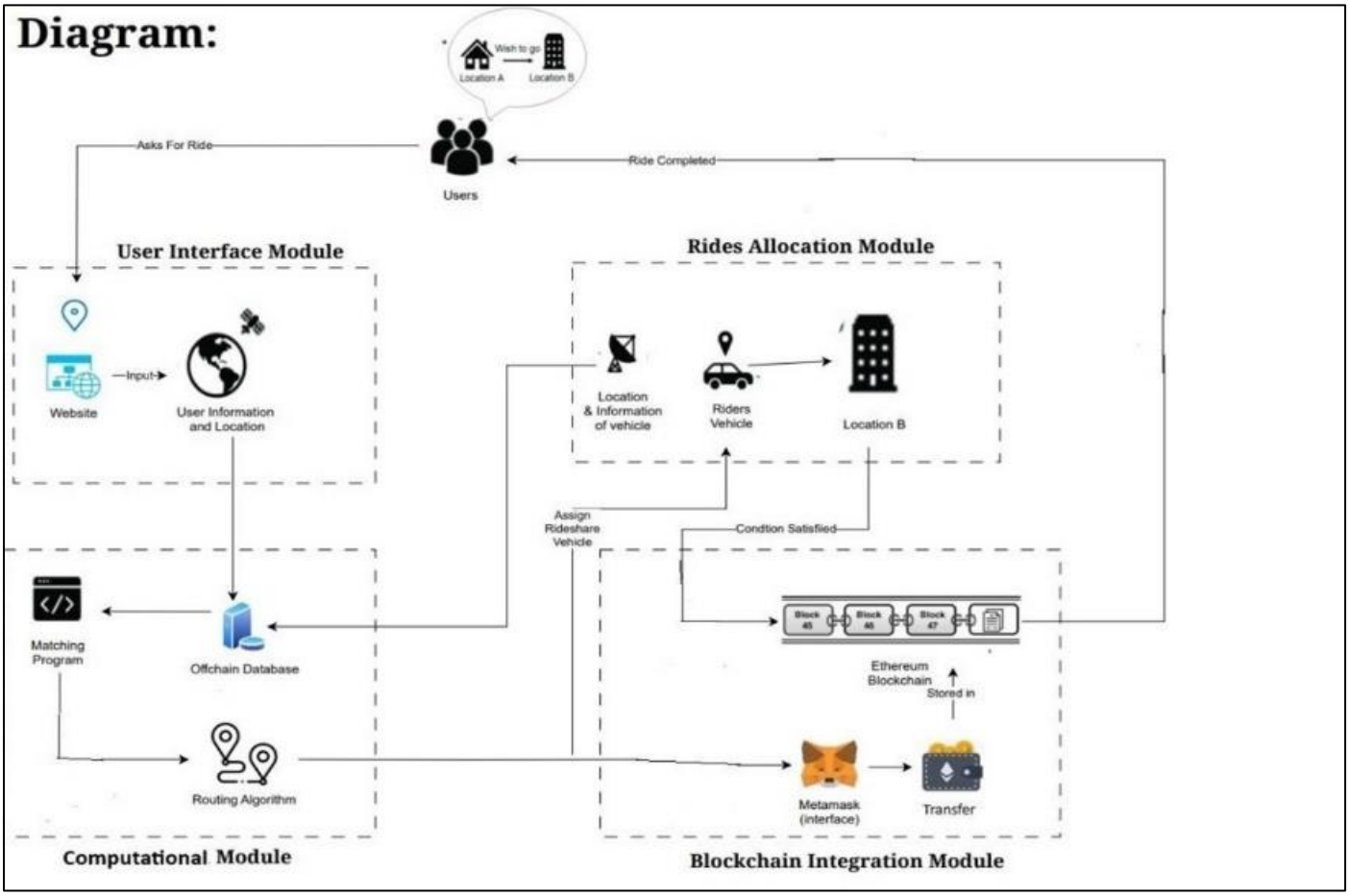

Fig 1 Architecture Diagram

➢ *User Interface Module:*

The User Interface Module used as the front-end component of the system, providing a user-friendly interface for passengers and drivers to interact with the decentralized ride-sharing platform. It includes web applications that allow users to request rides, view available transportation options, and provide feedback. User authentication and registration systems ensure secure access to the decentralized platform and enable users to manage their accounts and preferences.

➢ *Computational Module:*

The Computational Module is responsible for finding the best path for ride and responsible for tasks, such as route planning, demand forecasting, and pricing calculations. It contains algorithms and computational techniques to match riders with nearby drivers based on proximity and availability. Dynamic pricing mechanisms adjust fares in real-time based on supply, demand, and other factors to ensure efficient utilization of resources.

➢ *Ride Allocation Module:*

The Ride Allocation Module allocates the ride in an efficient and equitable manner, considering user preferences, real-time conditions, and system constraints. It optimizes ride assignments to minimize waiting times for passengers and maximize driver utilization, considering factors such as distance, traffic conditions, and driver availability. This module ensures a seamless and reliable ride-sharing experience for both passengers and drivers by dynamically adjusting ride allocations based on changing conditions.

➢ *Blockchain Integration Module:*

The Blockchain Integration Module is the foundation of the decentralized ride-sharing platform, leveraging blockchain technology to enhance security, transparency, and trust. Decentralized identity protocols are integrated into the module to enable secure authentication and verification of users, drivers, and service providers. By harnessing the advantages of blockchain, such as decentralization,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

distributed computing, and cryptographic security, the module promotes data sharing, trustless transactions, and resilience against cyber threats.

C. Proposed System

The Web Application encompasses numerous classes and activities essential for facilitating the overall functionality of the project. Like many prevalent ride-sharing platforms such as Uber and Ola, most existing ride-sharing applications rely on centralized third-party systems to furnish ride-sharing services to their clientele.

The Login and Registration service is equipped with a straightforward User interface, while the Google Firebase authentication service is integrated into the backend to manage and validate user login credentials.

For the map functionality, a map fragment is embedded within the map activity, extending various classes such as GoogleApiClient, Location Listener, Connection Callbacks, On Connection Failed Listener, and OnMapReadyCallback to execute essential map features like user location activation, location markers, map type selection, and more.

The frontend design of the application is outlined in the XML file, encompassing components such as login/registration forms, selection activity, map fragment, search bar, and drawers for ride requests and approvals.

To configure the map API, the GoogleApiClient is implemented in the main activity, with the map fragment configured through the OnMapReady method. This enables the execution of tasks such as padding adjustments, setting listeners for map events like onMapLongClick and onMarkerClick, building the GoogleApiClient, and setting the user's current location on the map.

In the Manifest file, permissions for accessing the internet, coarse and fine location are granted. The Location Listeners' methods including onLocationChanged, on Connected, onConnectionSuspended, and onConnectionFailed are implemented, with the location Request object initialized within the onLocationChange method to obtain the current location.

Within the Main Activity, the Search Bar's onQueryTextListener is configured to transmit the latitude and longitude coordinates of the searched address as the destination to the direction parser class. A Geocoder object is instantiated, and geocoder.getFromLocationName method is employed to retrieve the latitude and longitude of the destination. Upon entering a query into the search bar, the most relevant location on the map is displayed as a marker, and a polyline is drawn between the user's location and the destination. Subsequently, this coordinate data, along with other relevant entities, is relayed to rider requests and transmitted over the blockchain network.

A public class named TaskRequestDirections, which functions as an AsyncTask, is crafted to generate a response string serving as a URL to be dispatched to the directions API for polyline parsing. Another public class named TaskParser is devised to parse the polyline retrieved from the Directions API through an instance of the DirectionParser.java class, whose primary task is to construct polylines on the map based on input parameters.

Hence, the devised Android application is designed to interact with the blockchain via transactions, facilitating the exchange of user data through this mechanism. By amalgamating these contemporary technologies, a secure and resilient framework for ridesharing is forged, ensuring enhanced reliability and privacy in the process.

Present ride-sharing platforms, although operational and widely utilized, possess potential for refinement in terms of precise pricing structures, heightened security measures, transparent transactions, and safeguarding data integrity. Leveraging the decentralized network of blockchain technology, riders have the opportunity to directly interact with drivers, thereby mitigating the necessity for additional charges.

Individuals possessing smartphones and modern, secure vehicles stand to gain increased market opportunities due to the absence of intermediaries. The system delineated in this paper endeavours to achieve precisely these objectives.

The Web application generated from this process manages user ride-sharing requests, matching them with nearby drivers. Utilizing blockchain technology, users can seamlessly connect with peers through the application's matchmaking feature. Deployed on the Android platform, the system boasts user-friendliness, enabling users to book rides swiftly, securely, and with ease.

IV. OBSERVATION

Present ride-sharing platforms, although operational and widely utilized, possess potential for refinement in terms of precise pricing structures, heightened security measures, transparent transactions, and safeguarding data integrity. Leveraging the decentralized network of blockchain technology, riders have the opportunity to directly interact with drivers, thereby mitigating the necessity for additional charges.

Individuals possessing smartphones and modern, secure vehicles stand to gain increased market opportunities due to the absence of intermediaries. The system delineated in this paper endeavors to achieve precisely these objectives.

The Web application generated from this process manages user ride-sharing requests, matching them with nearby drivers. Utilizing blockchain technology, users can seamlessly connect with peers through the application's matchmaking feature. Deployed on the Android platform,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

the system boasts user-friendliness, enabling users to book rides swiftly, securely, and with ease.

Fig 2 Frontend Image

The depicted selection activity showcases a user interface where users are prompted to choose their destination from a list of available options. Following this, users are directed to login/register pages, providing them access to their accounts. Accounts are established and stored to maintain records of users' data and ride-share history accurately.

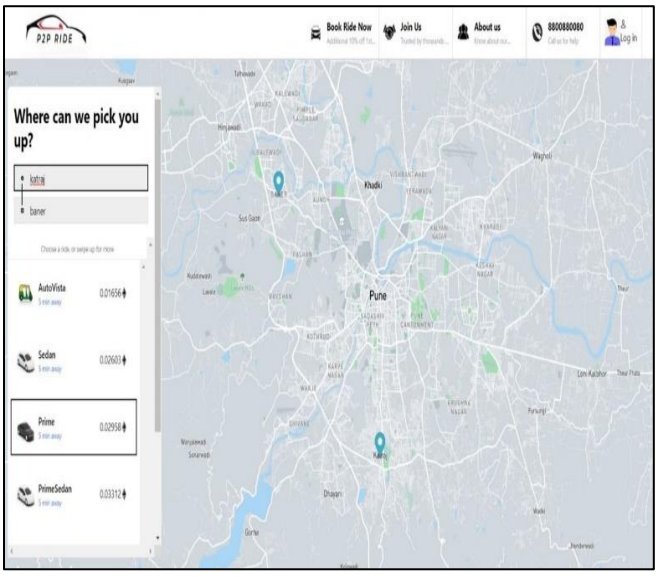

Fig 3 Map Image

The map fragment, allowing users to input their source and destination locations. Subsequently, users' data, along with the latitude and longitude of the source destination, are transmitted to the blockchain and logged as a transaction. This information becomes accessible to nearby drivers, who then have the option to either approve or deny the users' requests.

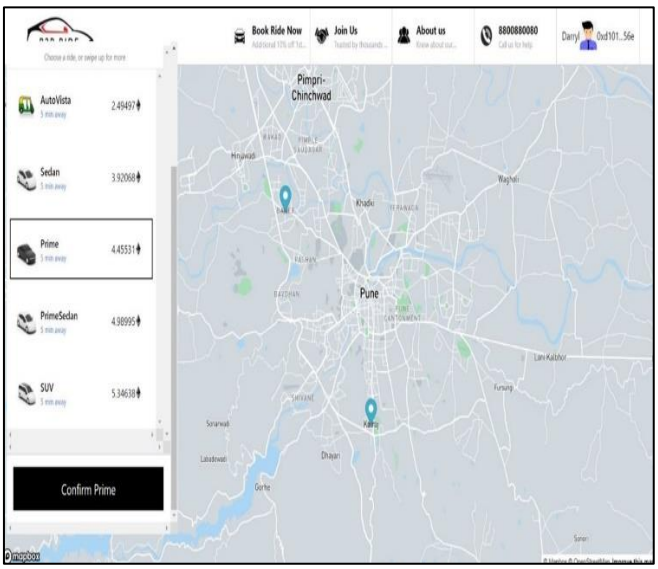

Fig 4 Ride Conformation Image

The application presents a snack bar to the user, indicating that the request is currently undergoing processing. Upon approval by any nearby driver, the application will display the driver's details to the user.

V. CONCLUSION

The primary objective of this paper was to explore the revolutionary potential of Blockchain technology. The article introduced a decentralized and peer-to-peer architecture for a ridesharing service, leveraging Blockchain. A decentralized application (DApp) was developed to facilitate this ride-sharing system, employing Ethereum, a permissionless public blockchain, along with cryptographic protocols to streamline network transactions and data sharing.

In brief, blockchain could be employed to create a system where digitally encoded smart contracts are stored in transparent and decentralized databases. These databases are designed to accommodate mutable data.

The system outlined in the paper aimed to decentralize ridesharing services, achieving this objective to some extent. By decentralizing the platform, advantages over centralized ones were realized. The implemented P2P Web Application offers ride-sharing services like those provided by established companies, maintaining a comparable interface and user experience. However, the core of the system operates on a decentralized basis. Users can seamlessly request or share rides through the proposed platform, effectively addressing and resolving the initial problem statement in a secure, manipulation-free, resilient, crash-resistant, and user-friendly manner.

In future endeavors, there are several aspects worth exploring. Firstly, delving into the technology from a data processing perspective is crucial, given that blockchain technology operates on a thrustless system, instilling trust in the data for users. Blockchain's cryptographic security mechanisms ensure that user data and transactions are

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24APR1397

protected from unauthorized access and tampering. While blockchain enhances the overall quality of data, it's essential to comprehend the data processing capabilities when integrating blockchain with larger software systems. Secondly, investigating the data processing demands on blockchain platforms can offer valuable insights into optimizing performance and efficiency.

The decentralized mobility solution enhanced with blockchain technology is promising a paradigm shift in the transportation industry. Through the integration of blockchain, the peer-to-peer transportation platform offers a secure, transparent, and efficient alternative to traditional centralized ride-sharing systems.

REFERENCES

[1]. Guo, X., & Guo, X. (2023). A Research on Blockchain Technology: Urban Intelligent Transportation Systems in Developing Countries.
[2]. Mahmoud, N. (2022). Ride-Sharing Services: From Centralization to Decentralization.
[3]. Lu, W., Quadrifoglio, L., & Petrelli, M. (2016). Reliability analysis of centralized versus decentralized zoning strategies for paratransit services. In World Conference on Transport Research - WCTR 2016 Shanghai.
[4]. Badami, M. G., & Kandlikar, M. (2016). Autorickshaw in Indian Cities: Public Perception and Operational Realities. Retrieved from ResearchGate.
[5]. Badr, M. M., Baza, M., Abdelfattah, S., Mahmoud, M., & Alas Mary, W. (2021). Blockchain-Based Ride-Sharing System with Accurate Matching and Privacy-Preservation. In International Symposium on Networks, Computers and Communications (ISNCC). IEEE.
[6]. Zhang, H., Deng, E., Zh, H., & Cao, Z. (2018). Smart contract for secure billing in ride-hailing service via blockchain. Springer Science Business Media, LLC.