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Data Reliability in Ridesharing using Blockchain

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A B S T R A C T

The car-sharing demand is continuously developing and lately it has evolved even more widespread than car right. However, the classic car-sharing scheme is founded on a centralized database server which can often lead to cracker attacks or password leaks. As noticed nowadays from a lot of use matters, the best solution to these challenging issues is to use blockchain technology. Blockchain as a decentralized, immutable, public ledger provides customers with security that is impossible to tamper with. A blockchain is basically a digital ledger of trades that is replicated and spread across the entire web of computer systems on the blockchain. User's data is sensitive and crucial, and blockchain can significantly change how user's critical information is viewed, by creating a record that can't be altered and is encrypted end-to-end, blockchain helps prevent fraud and unauthorized activity. The previous research's many flaws were revealed with a quick skim. The existing systems offered a solution to develop and implement peer-to-peer short-term car-sharing applications founded on blockchain technology and smart contracts. For the execution of smart contracts, the Solidity programming language is used. Solidity works with the Ethereum blockchain. The fundamental originality of this system is presenting a peer-to-peer car-sharing service without a central authority, which reflects a decrease in costs and an increase in data clarity in that system. Also, token-based solutions give us the power to protect business-to-business (B2B) and business-to-customer (B2C) use cases.

Keywords: Blockchain, Decentralized, Peer-to-peer, Ridesharing, Smart Contract

1. Introduction

The benefits of carpooling are well-documented, and it represents an effective solution to the problem of traffic congestion. By allowing drivers to publish their destinations or driving pathways on a medium, carpooling makes it possible for passengers with similar travel plans to find one another and share rides. This approach is highly convenient for passengers, who are able to save time and reduce the cost of their travel, while also reducing the number of vehicles on the road, which in turn helps to alleviate congestion and improve city mobility. In addition, carpooling is environmentally friendly, reducing vehicle emissions and noise. However, most current carpooling services are centralized, with all transactions taking place through a single platform. This centralized approach is vulnerable to a range of threats, including password hacks and the misuse of customer data. Furthermore, it requires significant effort and cost to maintain, making it less sustainable in the long term. To address these issues, the proposed decentralized ridesharing system is built on the Ethereum blockchain network. This approach removes the need for a centralized authority and provides a more secure, transparent, and cost-effective method of transaction. By using Solidity language for smart contracts, the system ensures that data is not misused by centralized authorities and provides a higher level of security, reducing privacy concerns for users. One of the key advantages of the proposed system is that it allows for verifiable transactions in the public domain.

This approach ensures that data is secured and verified by the public, rather than being controlled by a central authority. This, in turn, provides a greater level of transparency and trust in the system, which is essential for its long-term success. Overall, the proposed decentralized ridesharing system represents an innovative and highly effective solution to the challenges facing the carpooling industry. By leveraging the power of blockchain technology, the system provides a more secure, transparent, and user-friendly approach to carpooling, while also reducing the environmental impact of transportation and improving city mobility. Therefore, it is best to use a blockchain network to carry out all these transactions to make them verifiable in the public domain. In this way, the data is also secured and at the same time verified by the public.

2. Related Work

This section describes the various methodologies used in prior studies. Ivan Kotuliak [10] describe blockchain-based solutions for different use cases. It proposes a decentralized peer-to-peer application built on top of the Ethereum blockchain, using Solidity for smart contracts and HTML, JS for the client side. The system use Web3 as a connector to the Ethereum network and one types of tokens (ERC-721) to enhance scalability and security. The ERC-721 token represents a car asset. It also presents several scenarios for using this architecture in business-to-customer and business-to-business solutions. In the Barnali Gupta Banik [11], the authors propose a blockchain-based ride-sharing architecture using Ethereum and Truffle suite, with two types of coins to support drivers' remuneration. The authors use discourse analysis to evaluate the proposed system and establish a numerical model to calculate the benefits of each driver within the blockchain ride-share framework. Both papers highlight the benefits of using blockchain technology in their

respective domains. The first paper [10] emphasizes the advantages of decentralization and security, as well as the potential for scalability using different token types. The second paper [11] focuses on the benefits of using blockchain technology for ride-sharing, including enhanced trust, transparency, and cost-effectiveness. Both papers acknowledge the challenges of implementing blockchain solutions, such as the need for technical expertise, regulatory compliance, and user adoption. Overall, these papers demonstrate the potential of blockchain technology to transform various industries by providing secure, transparent, and decentralized solutions. The authors provide valuable insights into the technical, economic, and social aspects of implementing blockchain-based solutions, highlighting the need for collaboration, experimentation, and innovation. As blockchain technology continues to evolve, it is likely to play an increasingly important role in shaping the future of digital transformation.

3. Research Objectives

The problem with centralized ridesharing platforms like Uber and Lyft is that they act as intermediaries between the passenger and driver, taking a significant cut of each transaction. This not only drives up costs for passengers but also reduces the earnings of drivers. Moreover, the lack of direct communication between the two parties can lead to miscommunication and misunderstandings. The centralized body receives a minimum of 25% profit on each transaction from the amount paid by the user to the driver. As there is no system which stores user's data in a decentralized manner such a way that as soon as the ride ends the user's data will be converted into hash values (SHA-256) and eliminate the need of a middleman which will also result in prevention from selling the users data to the advertisement agency.

4. Proposed System & Methodology

4.1 System Flowchart:

Fig 1. explains the design of a flowchart for a system that authenticates driver/user data through smart contracts and stores all transaction information using Firebase and Ethereum blockchain. The flowchart demonstrates the system's process, beginning with the driver/user's authentication, followed by creating their profile or logging in using their credentials. Once authenticated, the driver/user can use the system freely, and all transaction data is stored securely on the blockchain and in Firebase.

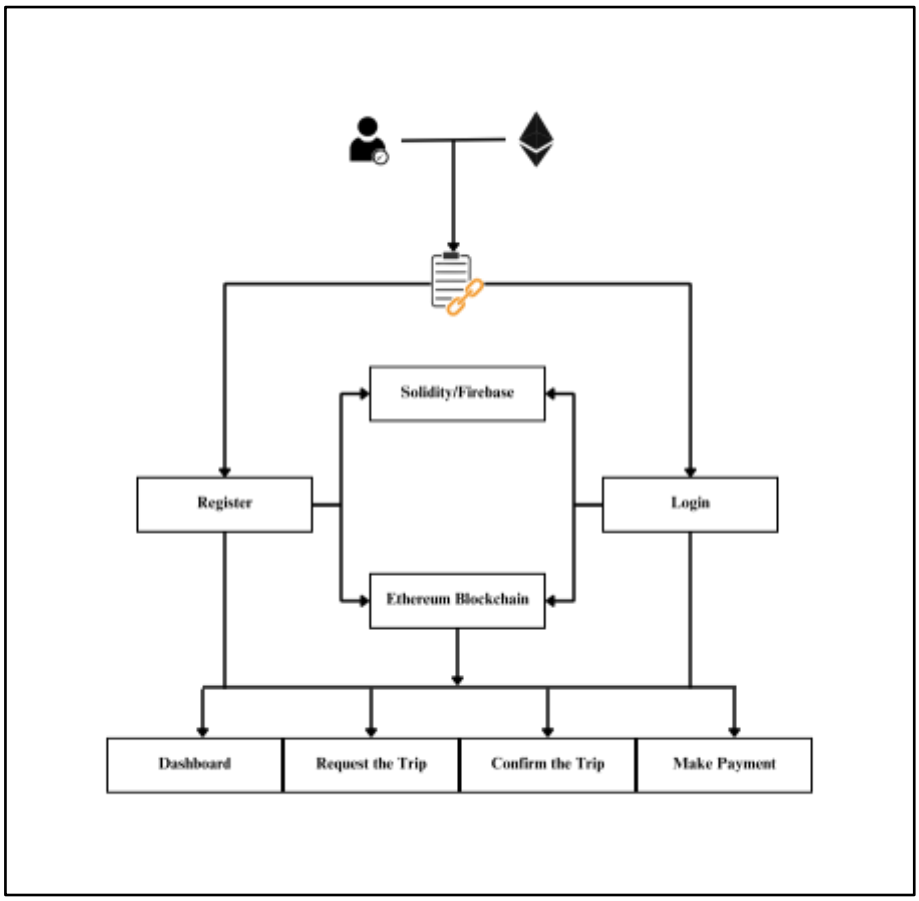

Figure 1. System Flowchart

4.2 Methodology:

Fabrication of the system starts with the initialization of the contract and to provide a high level of robustness and autonomy while addressing issues of trust, time-criticality and democratization, the proposed system shares a decentralized architecture with four building block tools which is the Ethereum Ecosystem, MERN stack, Solidity, Material UI. The system used the Firebase along with Next3.js, to store the user data such that it's decentralized and it will prevent any external sources from accessing the user's private information and allow faster efficiency rate.

The proposed system also utilized the Ethereum Ecosystem to securely store the smart contracts that the developer wrote to monitor each user. The Ethereum Ecosystem was necessary for the proposed application to fully flower as it was needed in the project. The system utilized ReactJS to develop the frontend for this application, by creating multiple pages for the user and also developing multiple components that will connect to the Express Backend. For collecting the location of the user certain map/location APIs were required, thus the Google Maps API was used to display the routes between one point on the starting and destination point and then developed by using a Higher Order Component which is a subset of Google Map API that will wrap over the initial Map component which will display the route between any two given points. For the proposed system there was a need to use the Web Geolocation API or Google Map API that would determine the current user's location on the decentralized web application. The proposed used the data from the API and the address that the user would input (their desired location) to properly route these locations. Later on, it also used the Material UI Library to style the components and properly make the application UI and UX friendly. The backend barebone consists of an Express Js with multiple routers for every single endpoint that would call everyone a single database function, and Smart Contract function.

Solidity's syntax and language were built in such a way that the developer cannot loop through the keys in a hashmap, because the proposed system stores all of the users on a hash map, it was necessary for the developer to loop through all possible drivers and send them to the passenger. Thus, it required a certain type of code function to do this, allowing us to access any key-value pair in the hashmap. The system needed the current user's balance to transfer the ether, the system needed to call it through the injected Web3 in the frontend which can be accessed from the Metamask wallet with a certain gas limit.

5. Results

This chapter provides the partial implementation and the screenshots of the result.

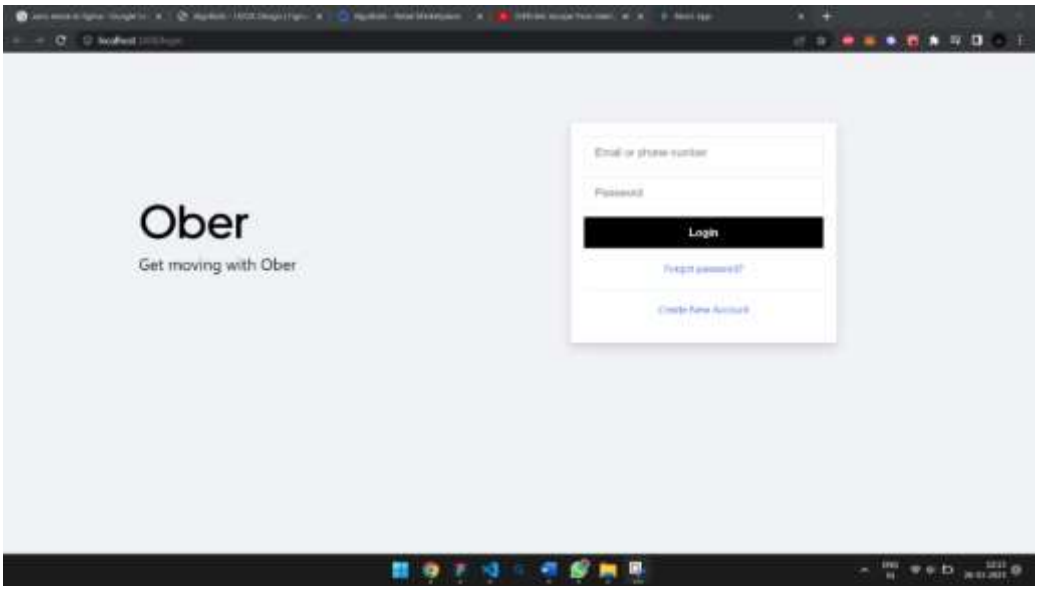

Figure 2. Login page for both the rider and driver

This figure 2 Login/Register page for both the driver and rider for specifying whether they are rider or driver002E

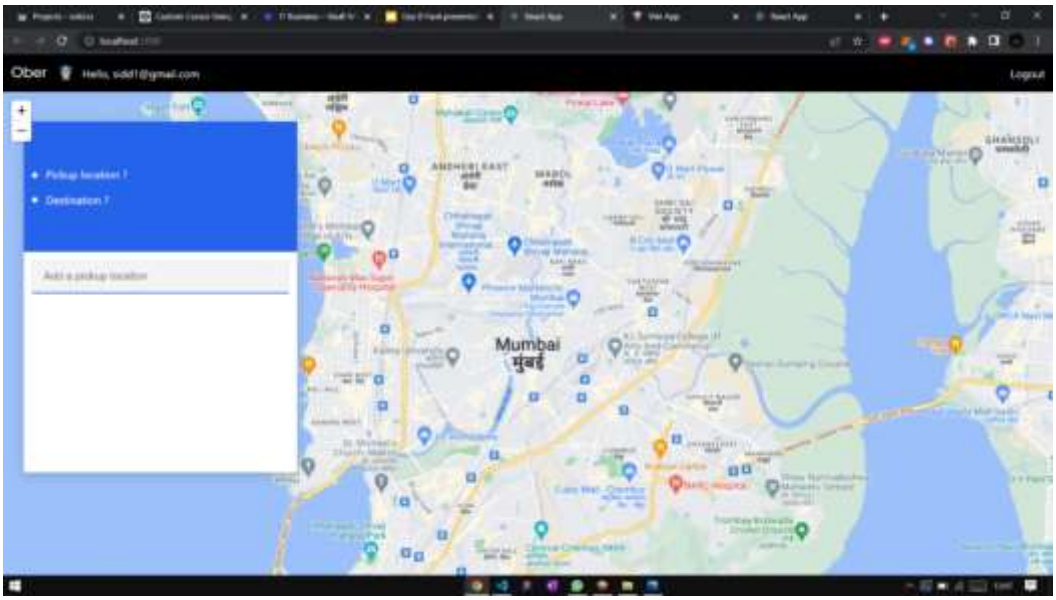

Figure 3. Ride request page for rider

This figure 3 UI of the page where rider will make request for a ride and the request will be published to the driver dashboard in real time.

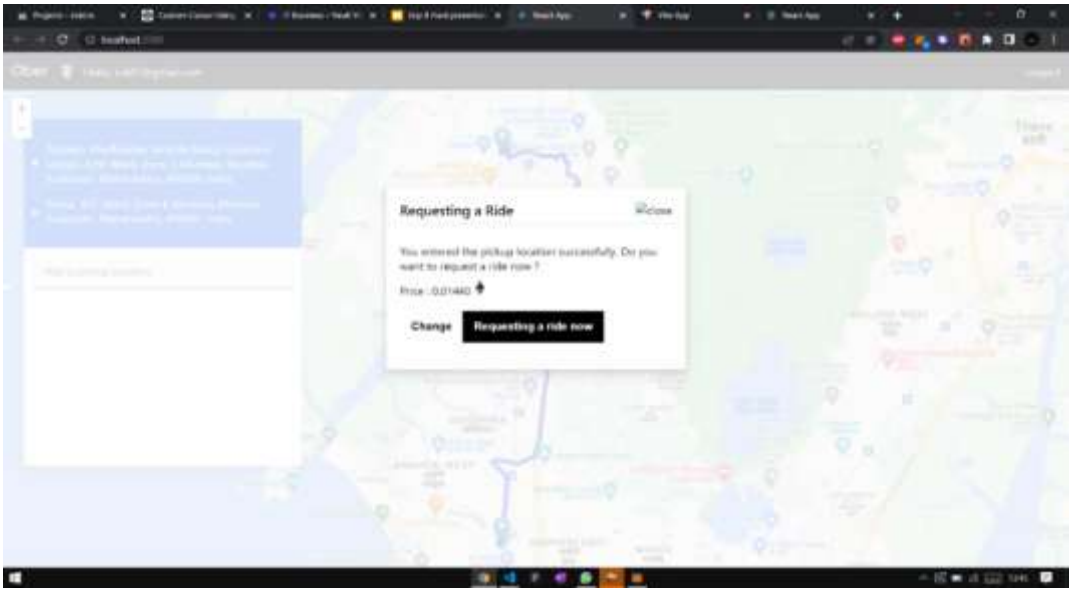

Figure 4. Modal for confirming the request

Figure 4 shows a modal after making the request before publishing it, a modal for showing the price in Ethereum required for the transaction.

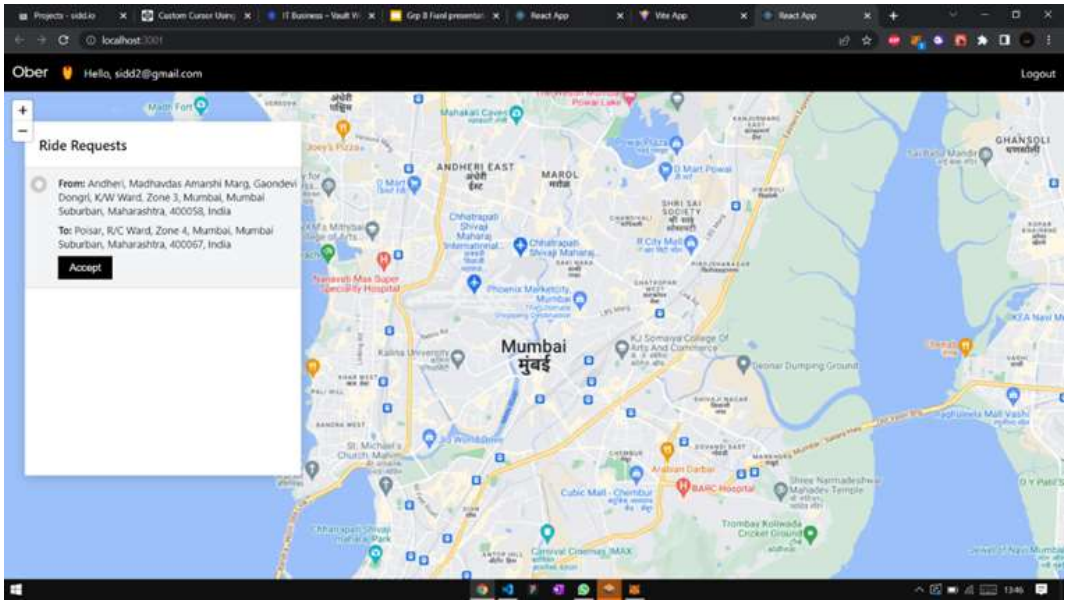

Figure 5. Driver dashboard

Figure 5 shows complete compilation of Authentication which will allow transaction and sign-in/login of customers/drivers.

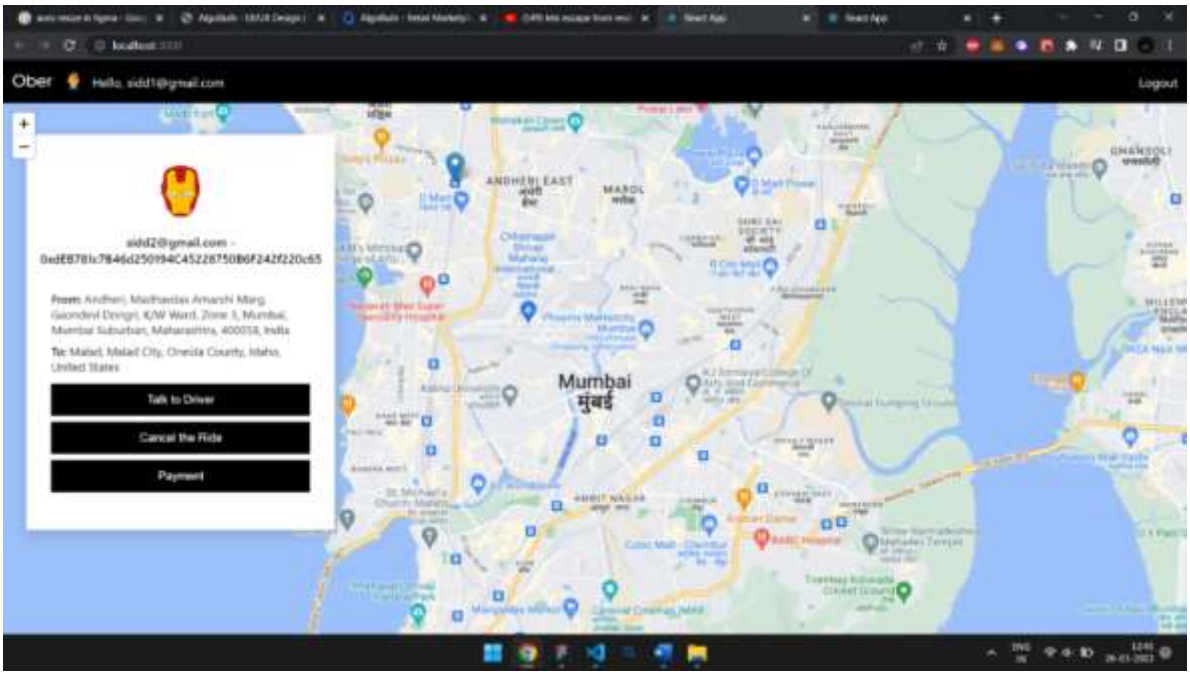

Figure 6. Rider page after the ride is successfully accepted

Figure 6 shows page where rider can have multiple option such as cancel the ride, talk with the rider and after the ride is completed do payment.

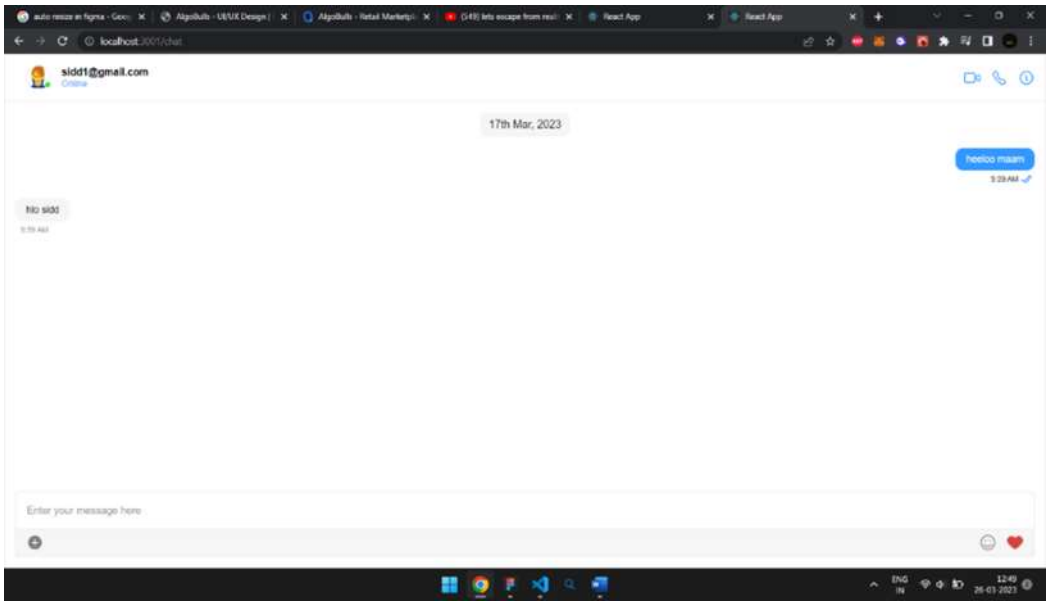

Figure 7. Chat page for rider and driver

Figure 7 shows API used for performing conversation where no Phone number and Gmail is used for performing conversation henceforth protecting one's identity.

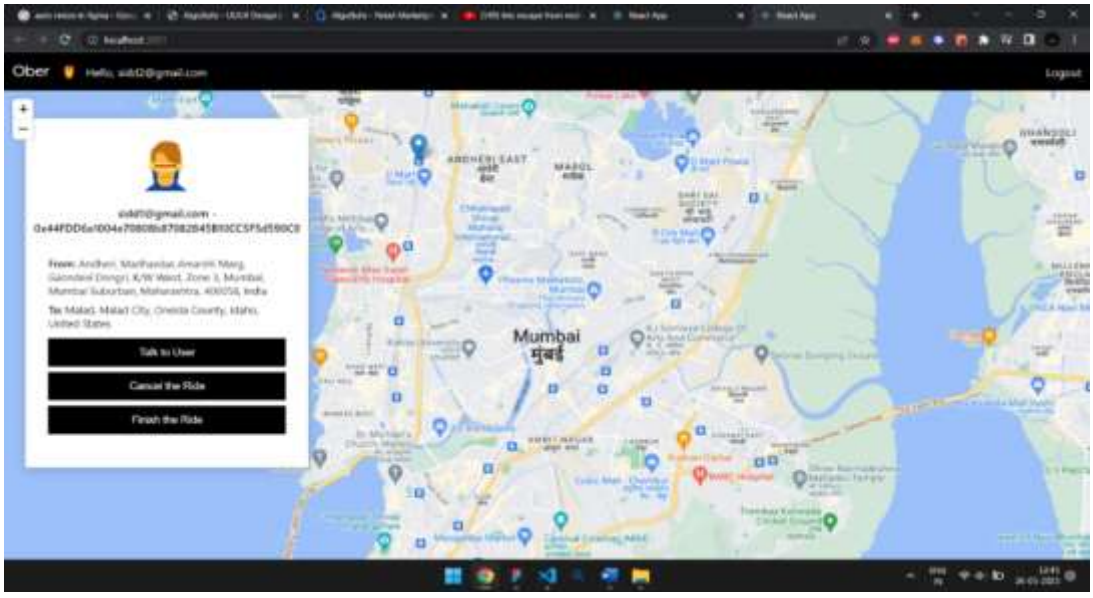

Figure 8. Driver page after the ride is successfully accepted

Figure 8 shows page where driver can have multiple option such as cancel the ride, talk with the rider and after the ride is complete, finish the ride.

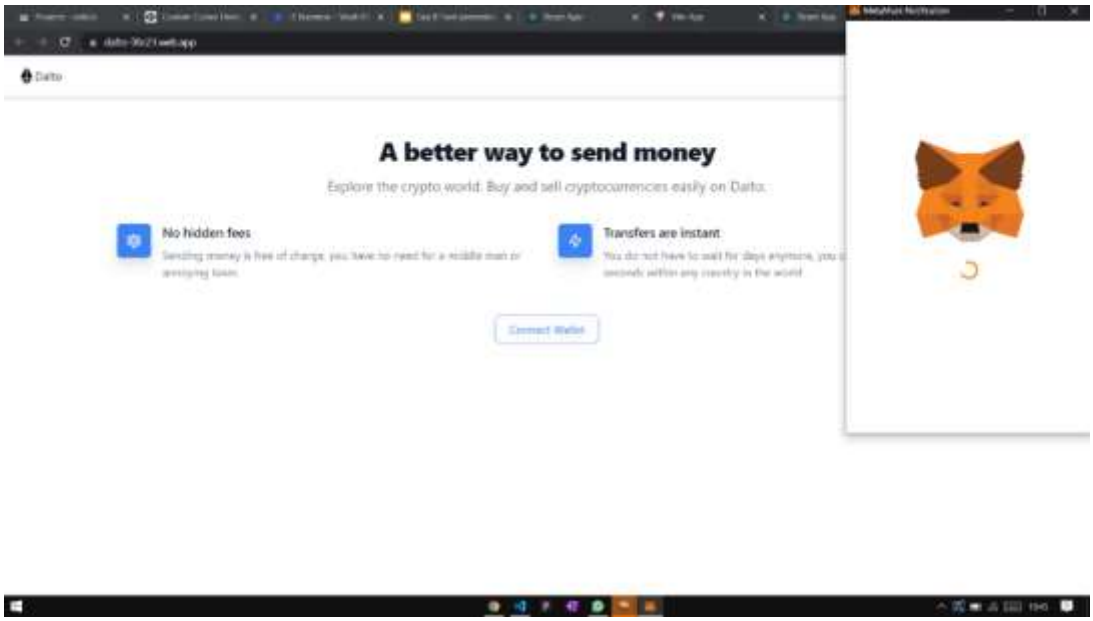

Figure 9. Payment Gateway

Figure 9 shows a gateway made by the developer so that rider can perform the transaction using MetaMask wallet.

Initially, the user has to register themselves in the system using hoax details so as to avoid the problem of unintentional information disclosure later on, they've to specify whether they are RIDER/DRIVER because on the basis of specification, both will have a different interface to interact with. Consequently, Rider, they have to provide their source and destination point, note that this project is built on GoogleMap API so all the location used in Google Map is available in this proposed system too, later on when the co-ordinates are registered in GoogleMapAPI, they'll get a prompt of showing their expense which will be in Ethereum format, then they've to request the ride and it'll be sent to Driver's dashboard.

Now in the Driver's section, where a request published by the rider will be displayed on the dashboard, the driver in the vicinity can accept the request and help them move from their source to the destination place, if the rider or driver has any sort of issue, they can communicate with each other using CometChatAPI where they can communicate with each other in any way possible such as Chat, Video Call, Phone Call, without sharing any individual personal information to both the entity. After completion of the ride, the rider must pay to complete the requested ride, now for the transaction the user is moved to a new payment gateway created by the developer where they will connect their MetaMask wallet and later on enter the wallet address of driver which can be seen in the rider page and then pay the required Ethereum and finish the ride, Eventually receiving the Ethereum driver will finish the ride and check for any new ride in his vicinity.

4. Conclusion

This paper proves decentralised ride sharing system will provide car service without the need for central authority, which will be reflected in the reduction of cost and provide transparency of data. It will also make sure that the privacy of the user is not compromised. To link to the Ethereum web Solidity will be used. Using Solidity language for smart contracts helps to remove centralized issues and is safe and more secure. This will reduce the privacy issues and data will not be misused by centralized authorities.

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