ITM Web of Conferences **44**, 03023 (2022) https://doi.org/10.1051/itmconf/20224403023
ICACC-2022

EtherRider: A Decentralized Intercity Ride-Sharing Platform using Block-Chain Technology

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Abstract: Ridesharing entails the sharing of journeys in order to make optimal use of fuel by allowing people to go along the same route to share rides. It allows regular passengers to share trips with others, having the additive benefit of lowering travel costs and reducing traffic congestion. Most current ride choices rely on a centralized authority to enable the system, leaving it vulnerable to faults at a specific point in the system and raising concerns about privacy disclosure to attackers acting both within and outside. Furthermore, they are vulnerable to external threats and fraud, and the payment made by the current ride-sharing service provider is rather costly. As a result, we have proposed the system named EtherRider, based on the Ethereum blockchain technology. EtherRider enables drivers to provide transportation services without the need for a central system. Both the passenger and the driver will know about sharing ride details, secure their travel details, such as pick-up and drop-off locations, arrival/departure times, and secure payment through the ethereum blockchain.With a distributed ledger, drivers and riders could create a more user-driven,value-oriented marketplace.In the context of car-sharing systems, our work also indicates that the design of such an integrated platform is dependent on striking the correct balance between important design concepts (such as security and privacy, authenticity, traceability and reliability, scalability, and interoperability).

1 Introduction

With the rapid advancement of vehicular technologies, today's crowded world necessitates ultra-fast moving cars. Transportation should be enhanced to be convenient and safe for every entity with a well-planned traffic system. All of these things depend on the vehicle's speed, which is proportional to the amount of traffic on the road. According to statistics, in recent years the amount of automobiles per person has increased around the world, resulting in delayed vehicle traffic because of the limited capacity of the roads. To steer clear of them, the key purpose should be to encourage efficient usage of car capacity, i.e., people who own vehicles should be advised to make use of them as part of mass transit [8-9]. One of the most extensively used and effective modes of public transportation is the mass transit system. Although mass transit can mitigate some of the negative effects of private vehicles, it lacks flexibility and reliability. The majority of ridership is centered on a few routes. It also has the disadvantage of having a lower occupancy per vehicle, with most buses moving empty seated during off-peak hours and regularly becoming overloaded during peak hours. As a result, consumers who seek a comfortable ride rarely use regular public transportation. The Ride-Sharing System, which matches drivers with other riders who want to travel the same or a similar route, is a more effective and efficient technique. It can be a manually matched ride-sharing where drivers who want to create a carpool pick up passengers waiting by the roadside.[10] The Ridesharing technology automatically compares the information to those of other users in the database and suggests possible Rideshare partners. The goal is to plan requests in real-time and reduce user trip time while ensuring service quality. Blockchain is different from the conventional client-server approach. Blockchain is a provable, immutable, and distributed ledger that allows mistrusting entities to deal with one another without depending on a central third party [1]. Smart contracts are self-contained computer programs that operate on a Blockchain network. These computer programs function as smart contracts, having the capacity to execute and enforce without the necessity for a centralized authority [6].

2 Literature survey

In paper [1], "B-Ride: Ride Sharing with Privacy-preservation, Trust and Fair Payment atop Public Blockchain" uses the time-locked deposit protocol in which both the rider and driver make deposits are used along with leveraging smart contract and zero-knowledge proof to make sure the rider and driver have goodwill. But in this system the initial deposit made by the rider directly goes to the driver

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upon the driver's arrival, a dishonest driver can just collect this down payment without committing to the offer.

In paper [2] "Privacy-Preserving Authentication Scheme for Connected Electric Vehicles Using Blockchain and Zero-Knowledge Proofs", zero-knowledge proofs to Blockchain are used for enabling privacy-preserving authentication. The author uses a token-based method for anonymous authentication. This system is only used for anonymous registrations of electrical vehicles and not for ride-sharing.

In paper [3] "PEBERS: Practical Ethereum Blockchain-based Efficient Ride-Hailing Service" uses a system in which smart contracts are deployed by the driver. It is profitable for the driver and reduces the expenses of the passenger. This system does not track the completion of rides and a driver can cheat the system by reporting false elapsed distance, therefore, lacking fair payment.

In paper [4] “Boosting Ridesharing Efficiency Through Blockchain: GreenRide Application ” uses Truffle, Ganache Metamask for the development and deployment of smart contracts, and Google Firebase for data storage. This system developed GRT(Green Ride Token)which is rewarded to users for every kg of CO2 reduced via sharing rides. This application is used only for corporate and universities and not for long trips.

In paper [5] “Implementation of a secure ride-sharing DApp using Smart Contracts on Ethereum Blockchain” uses MongoDB to store driver’s documents on profile creation, which are later validated by the legal authorities present on the Blockchain. This system involves a third party to authenticate the users in the system and also perform background checks on the user's personal data.

From the literature survey, it has been observed that the existing system has some limitations. In paper [1] time-locked deposits are used to ensure the trust of rider and driver but the driver can still cheat the system by not committing to the offer.

In paper [2] zero-knowledge proofs are used but the system is only used for the registration of users on the Blockchain and not for developing a secure ridesharing platform.

In paper [3] deployment of smart contracts is done by the driver which is profitable for the driver and rider as it costs fewer GAS fees but the driver can sometimes cheat the system as there is no ride tracking in the system.

In paper [4] the application distributes GRT which encourages the users to carpool but it is not used for long journeys, it is only used for corporate carpooling and in universities.

Considering all the above-mentioned systems, the proposed system has a fair payment system where a driver cannot cheat and it must be suitable for ride tracking for long journeys.

3 Proposed methodology

The flow of the proposed system is depicted in Figure 1. The rider fills out the necessary information for the ride, such as the pickup location, the destination, and the pickup time. Following that, the application will present the rider with a list of drivers who match the information provided by the rider. In order to ride, the Rider must choose one driver based on their preferences. A notification is sent to the Driver when the Rider selects a Driver. The driver will proceed to pick up the Rider from the predetermined pick-up location at the predetermined time if the request is confirmed by the rider.

When the ride begins, the Rider and the Driver will each place a small amount of money into the time-bound deposit. The Driver is required to provide the rider with proof of the distance traveled at each time interval. The Rider must determine whether or not the distance traveled is accurate. As the ride progresses, the rider will deposit money into the time-bound deposit as soon as the distance has been confirmed. The payment is made possible through the use of Metamask[7] which serves as a wallet for transactions conducted over the Blockchain.

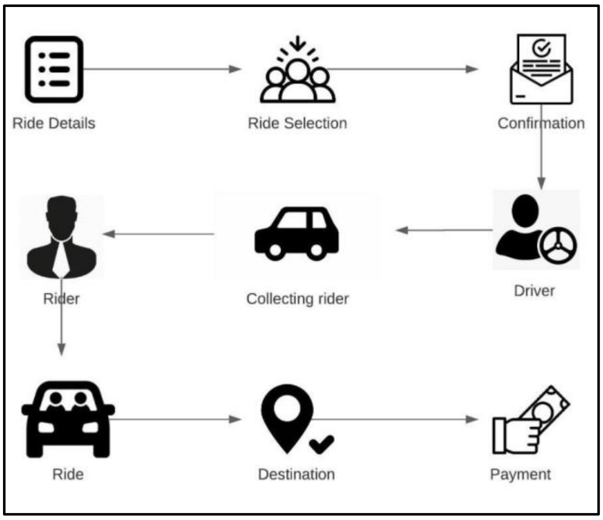

Fig.1. Flowchart for Ride-Booking Application

The following are our primary contributions:

1. A time-bound deposit mechanism and set membership in zero-knowledge are used to build confidence and belief between rider and chosen driver.

2. Create a prove-or-mulct mechanism that works as stated: The rider must produce a smart contract with a time-bound deposit amount, as well as a list of obscure spots on the map.

3. The accepted driver should deposit a sum as a commitment to his/her offer. In addition, verification of the driver's arrival at the pick-up place must be updated on the Blockchain. Finally, the smart contract validates all proofs in a zero-knowledge approach and either rewards or penalizes the driver based on their validity.

4. We also recommend an approach for assuring fair remuneration between the driver and the passenger. To validate an elapsed distance, the passenger must sign it with

his private key. The smart contract sends the collected fare to the driver when the rider generates the elapsed distance receipt. The driver is paid while driving in this manner.

The Blockchain also only stores elapsed distances, exposing no other vital data to the public. Based on previous acts, the algorithm calculates a driver's reputation. Unlike current centralized reputation systems, our decentralized profile management system on the Blockchain is self-enforcing if a set of prerequisites are met.

3 System Design

On the registration page, the user will enter his/her email id, Name, Phone Number, and Password. Then the system will check if a user with the same email id exists or not. If the email id already exists. Then the user will be directed to the login page if the email id does not exist, then-new an id will be created and the user will be directed to the Mainpage of the system.

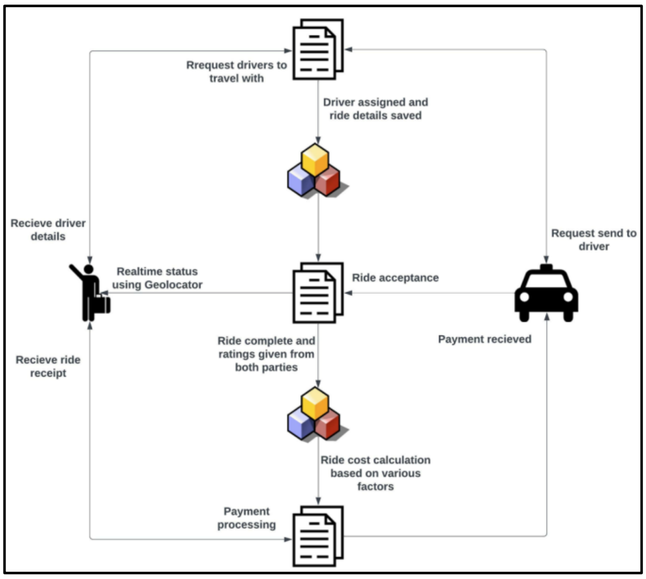

Fig.2 System Architecture

Figure 2 shows the system architecture of the proposed system. The rider will select the location they want to travel to and then will see a list of drivers who are also going the same way. The Rider then needs to select the Driver he/she wants to travel with based on their rating. Then the Driver will meet the rider at the pickup location specified by the Rider.

After the ride starts the ride details will be saved and after the end of the ride, the Ride cost will be calculated based on various factors like distance covered, the type of vehicle. We will be using pseudo-codes to implement smart contracts.

The Rider will be redirected to their metamask account. Using the metamask account the rider will pay the driver the calculated amount. After that, the Rider and Driver can rate each other on the app. This Rating will be displayed in the profile of both the driver and Rider and will help others to select their rides based on it.

4 Results

4.1 Implementation details

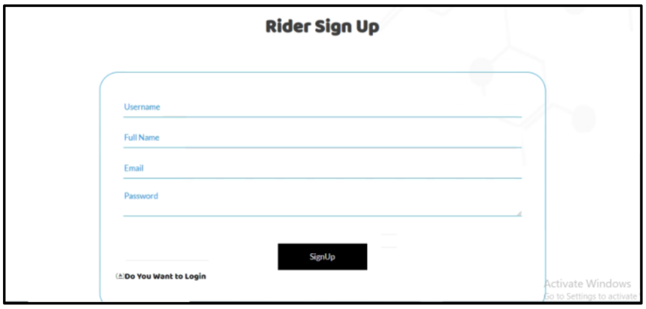

Fig.3 Rider Sign UpPage

From the user, the registration page takes four inputs: Name, Email, Phone, and Password; and the data is stored on the Blockchain. After logging in to the app the user requires to enter the registered email address and password on the login page.

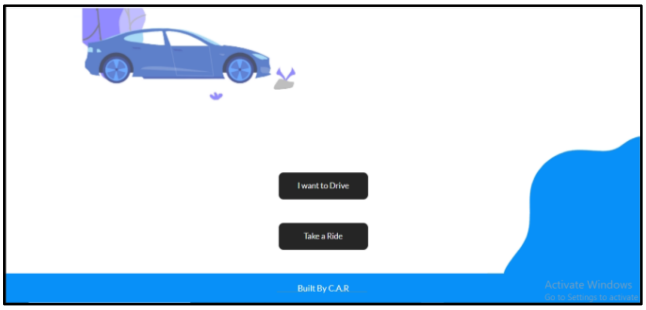

Fig.4 Role Selection Page

Fig.4 shows the role selection page, on this page the user will be able to select if they want to be the rider (Book a Ride) or the driver (Offer a Ride).

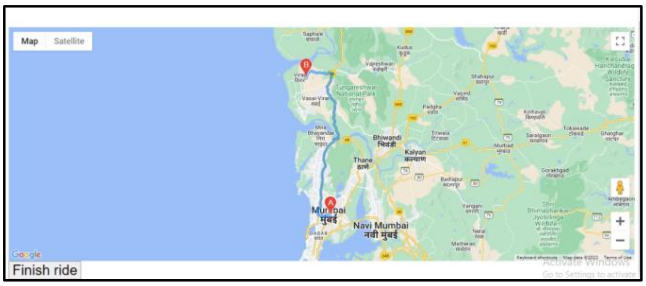

Fig.5 Live Location Tracking

Fig.5 shows the live location tracking page, the user location tracking is an important factor as it is being used to get the periodic live location of both the driver and the rider. The

Point A and B depicts source and destination respectively of the journey.

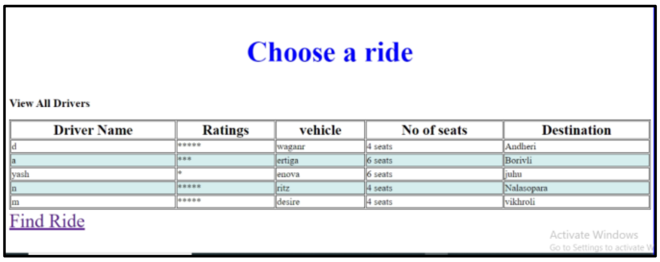

Fig.6 Driver selection

Fig.6, displays the available drivers who happen to be traveling towards the location the rider intends to be; the application provides details of the drivers(name, ratings, type of vehicle, destination) to the rider for selecting a better option to travel with.

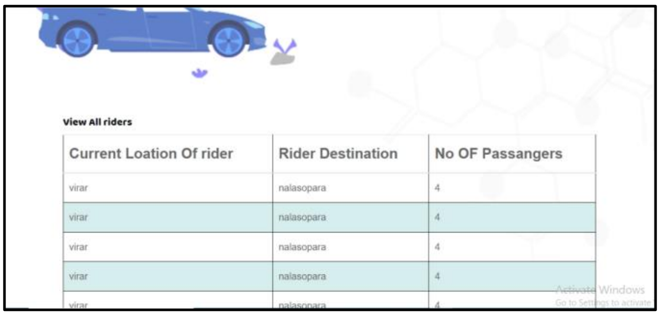

Fig.7 Rider selection

Fig.7 displays the current location of the rider along with the destination and number of passengers each rider has requested from the driver. The driver can select a rider based on this data.

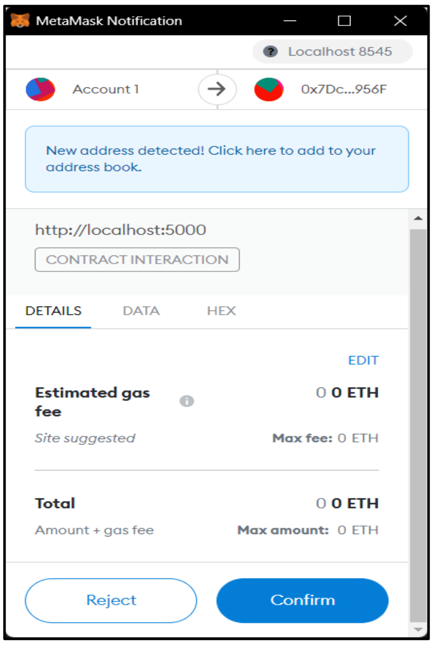

Fig. 8 Payment Request Page on Metamask

Fig.8 Metamask transaction request page, this page displays gas fees the user has to pay.

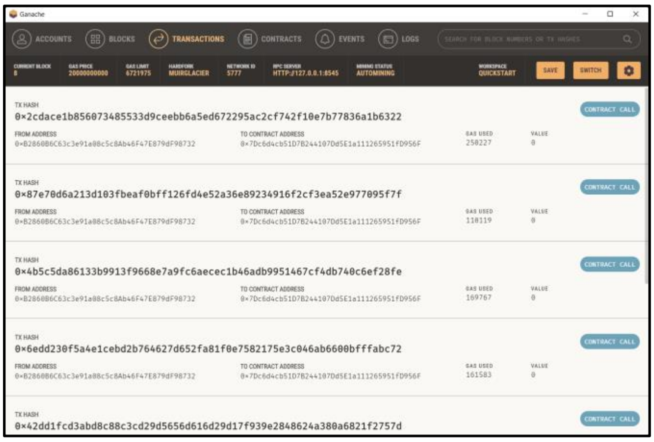

Fig.9 Ganache Transactions screen

Fig.9, Shows the Ganache Transactions screen, this page displays the previous transactions made by the user.

4.2 Performance Analysis

Table 1 describes the comparison between the traditional system and the Blockchain system proposed. Since there are many benefits of using Blockchain in a way that covers the limitations of the existing system and provides benefits of the proposed system.

Table 1: Comparison of Traditional System and Proposed system

Criterion	Traditional / Existing Charity Donations	Proposed System
Methodology	Physical records	Digital ledger
Reliable	Can lead to mishandling official documents.	More reliable.
Cost	Cost for registration and maintenance.	No additional cost.
Safety / Immutable	Physically stored data can be tampered	Impossible to tamper data due to security algorithms.
System Design	Centralized	Decentralized network
Security	Less Secure	More Secure
Speed	Slow	Faster

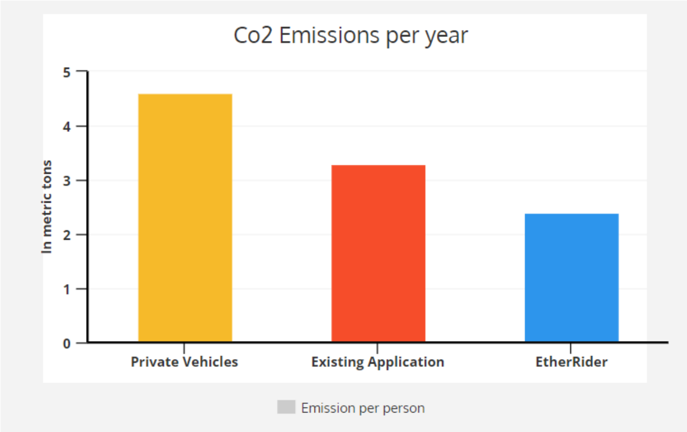

Fig10. CO2 Emissions comparison of private vehicles, existing centralized ride sharing system and proposed system decentralized ride sharing system, EtherRider

Figure 10 depicts the comparison of CO_2 emission values (in metric tons) by Private Vehicles, the Existing ride-sharing system; and our proposed system using blockchain. Private cars produce a burst of pollution every time the engine is started; previous research has found that cold-start air pollution is roughly equal to driving a car 200 miles. Since ride sharing runs more or less continuously, they avoid that.

5 Conclusion

This work has been carried out to provide a more secure and transparent application for ride-sharing to the users. As a result, we have proposed EtherRider -a ride-sharing system with a secure decentralized payment facility through the use of progressive public Blockchain technology. The current trends in the application of Blockchain technology will aid in the development of a system more fraud-proof and more reliable.

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