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Decentralised Ride Sharing System

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Abstract:- The ride sharing system is a centralized system where customers depend on the service providers for the setup, tracking, cancellation, fare calculation etc., of the rides. Also, the fairness involved in the ride is destroyed by any vicious activity in a centralized server-based system and causes inconvenience to both the drivers and riders. Therefore, we have implemented a blockchain application on Ethereum platform which decentralizes the system and hence ensures fairness of the ride.

Keywords:- *Ride Sharing; Decentralised; Blockchain; Fairness; Ethereum.*

I. INTRODUCTION

In today's world, transportation should be trust worthy and convenient for every individual with an efficient system for public transport. The number of vehicles per person has increased drastically over the last few years, all over the world, which results in slow traffic movement. So, a solution to this would be the full utilization of the vehicle's capacities, i.e. a vehicle owner shall be encouraged enough to use his vehicle as part of a public transport system. Thus, this would result in smooth traffic movements and would also somewhat help in reducing the air pollution levels. It would all be possible if the vehicle owners and riders find the platform simple and convenient to use, cost efficient and fair.

The ride sharing system which currently exists, provided by institutions like Uber and Ola, is centralized. It is a trust-based system which has centralized servers to monitor all the details of every ride. This kind of system appears to be less transparent and has safety concerns related to the customer and his information. Centralization leads to the systems being questionable; in terms of data integrity and flexibility.

In this paper, we try to implement a new system, inspired by blockchain, for the ride sharing application. Blockchain is a shared database that records every transaction [1]. Transaction can be as simple as sending money to someone in the network. In our ride sharing application, blockchain helps in achieving decentralization by letting the drivers and riders connect directly to each other through the app without any involvement of a third party, and implementing all the procedures such as ride set up, fair calculation and payment. This makes the whole system transparent and increases its reliability and fairness.

II. LITERATURE SURVEY

Satoshi Nakamoto is the one who invented the cryptocurrency Bitcoin and deployed the first digital currency [2] and also helped in implementing the first Blockchain. Blockchain is a collection of individual blocks which are stored as an immutable ledger that helps in maintaining records in a trust less system. By employing a hash key, each block is connected to the one before it.

After the advent of the first generation blockchain, Vitalik Buterin has developed Ethereum that has become the second-largest blockchain next to Satoshi Nakamoto's Bitcoin [11]. While Bitcoin focused on the development of a system where peer-to-peer digital currency transfer becomes easy; Ethereum also focused on providing a framework on which the developers can execute their decentralized Applications.

Giuseppe Antonio Pierro, Roberto Tonelli, and Michele Marchesi [3], speak in their paper about how 2nd generation blockchain offers the ability to code the smart contract in a Turing complete programming language which helps developer to write the smart contract using all the tools present in a traditional software system.

A smart contract is a program or protocol which is immutable and intended to do certain things based on the rules and ways laid out in the contract. These smart contracts are deployed and stored on a blockchain-based platform that is accessible to all.

The above-explained smart contract can be used in a variety of use cases where two or more parties are involved. Ridesharing is one such use case where a smart contract help transacts in a trust less manner between the rider and driver without the help of a central server.

We can leverage blockchain technology, existing peer-to-peer networks, and smart contracts to eliminate the need for a middle man (central authority) when the connecting riders in need of someone willing to share their ride.

Blockchain does not eliminate trust but rather minimizes it by distributing trust among various nodes rather than just trusting a central server.

Bitcoin in its original state doesn't support smart contracts, some other cryptocurrencies working on the same blockchain principle extend support for smart contracts.

Ethereum is one such blockchain that helps developers in deploying and executing decentralized applications, which are coded in Solidity [3]. Such smart contracts are immutable which has both pros and cons. The cons being that the bugs can't be fixed once the code has been deployed and the pros being that the system is immutable and the rules can't be changed which ensures trust in the system.

Ref. [4] Noted that the annual congestion cost is around 160 Billion dollars, therefore it is necessary to take steps towards a system where carpooling is more prevalent.

Ref. [5] noted how centralized ride-hailing platforms are vulnerable to security risks and sometimes can even fail to disclose any data breaches. These platforms are vulnerable to DDOS attacks as they have a single point of failure.

In their case study Salam Khanji, Sameer Assaf talks in his paper about how the transport sector could heavily reduce co2 emissions by using a ride-sharing alternative to each person using private vehicles in places with poor public transport infrastructure [6]. The paper quotes the example of Jordan where co2 amounts could be reduced by 5% on average annually and a cost of around 300 to 450 million dollars could be saved in direct and indirect expenses

Ryan Shivers, Mohammad Ashiqur Rahmany, and Hossain Shahriarz point out how running a ride-hailing platform is very costly and has the risk of a single point of failure [7]. The paper also talks about how vehicle owners can benefit from a decentralized application by providing services to a large network of users without having to depend on a third-party service or having to create an independent application. This helps in providing flexibility. Blockchain technology helps the vehicle owners participate in the network by taking on some responsibility for maintaining the infrastructure.

The paper by Panchalika Pal and Sushmita Ruj discusses how payment fairness is important when building a decentralized ride-sharing application [8]. The driver should be guaranteed that he will receive his payment once the ride is completed. At the same time, the rider should be ensured that payment will go through only after he confirms the completion of the ride.

Research of Mohamed Baza, Noureddine Lasla, Mohamed Mahmoud, Gautam Srivastava, and Mohamed Abdallah on making a blockchain-based ride-sharing service which is known as B-Ride [9] helps in preserving the privacy and trust between the riders and drivers. A point to be from this research is that their work is the first which integrate ride-sharing services and open blockchains. Their main focus is to get rid of the middle man between the riders and drivers and make the use of blockchain and smart contracts a household name for future ride-sharing services.

One of their focus in their research is to make sure that the transaction between the rider and driver be done in a trust less and fair manner which can be done with the help of a smart contract that transfers the fare to the driver.

They used their application together with Ethereum which is a real-world public blockchain.

Sowmya Kudva, Renat Norderhaug, Shahriar Badsha, Shamik Sengupta, A.S.M. Kayes proposed a system where users will interact with the fog computing nodes (Road Side Units) that acts as a validator and agent who find and match drivers with passengers [10]. It also talks about how the gas fee varies according to the storage required. It cost around 20000 units of gas for every 256 bits of data. Therefore, it is important to use as less of space as possible to reduce the gas fee per transaction which is eventually paid by the rider and the driver.

III. APPROACH

We implement our ride sharing framework using two peers, driver and rider. Any individual can use the app as a driver or a rider at a point of time. The rider can create requests for a ride which reaches all nearby drivers and the ride is confirmed if any of the drivers accepts the ride. The calculated fare amount is presented to the rider before the ride starts and after the ride is completed, the fare amount is transferred to the driver's wallet (in ethers). The payment procedure is handled with the help of smart contracts using blockchain.

The following modules used in the smart contract provide the core functionality of the proposed system and will be called by the client application by both drivers and riders at different points of time to facilitate the ride-sharing process:

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- *Initialize ():* this function is used to set/initialize the address of the nodes, i.e. driver and rider. It is also used to setup the ride fare amount.
- *FundRide ():* through this function, ride fare amount from driver's wallet is being transferred to the smart contract, after the ride has been confirmed and before the ride starts.
- *ConfirmRide ():* this function is used to confirm if the ride has actually been completed and the rider has reached its destination.
- *ReleaseFunds ():* this function is used to transfer the ride fare amount to the driver's wallet from the smart contract after the ride is successfully completed.

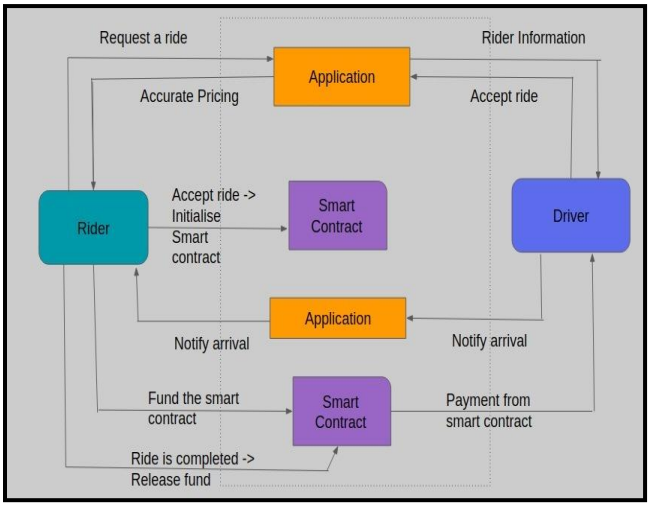

Fig 1: High level design of the application

These functions are invoked by the client application at different points of time to provide the base ride sharing service.

The application starts with a main screen, where the user is provided with two choices, to become either a rider or a driver.

Fig 2(a): user switching

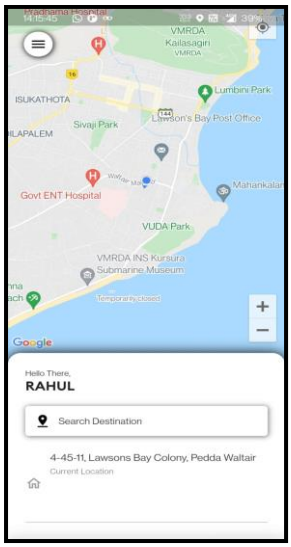

Fig 2(b): rider UI

When the user selects his choice, he is presented with basic login functionality. If the user is new, he is supposed to register on the application by entering his basic personal details along with his wallet address. In case of registering as a driver the person also has to enter the amount, he would like to charge per kilometer in rupees which he can update in his profile from time to time.

If the user has logged into the application as a rider then, he is presented with a screen with the map pointing to his current location as shown in figure 2(b). The latitude and longitude of his current location is updated in the application once the rider click the allow button to detect its location. Then the rider is supposed to enter the destination where he seeks to go and search for drivers. This request for a ride is sent across to all the online drivers who are nearby the rider's location. If a driver accepts the request, then the information is sent to the rider along with the fare details. The fare for every driver can be different. The amount charged per km by a driver is multiplied with the total distance in kilometres between the rider's current location and destination to which the rider is going to travel to, this gives the fare of the ride. After receiving the fare details, the rider can accept or cancel the ride. Once the rider accepts the ride details, the *initialise ()* function of the smart contract is triggered where the driver's and rider's wallet address and fare amounts are initialised in the ledger. Also, the fare amount is converted into ethers for the transaction.

After the driver reaches rider's location and starts the trip for the destination, the *fundRide ()* function of the smart contract is invoked. This makes sure that the driver will receive payment for his service. Through this function, a transaction is initiated in the blockchain, in which the ride fare amount is transferred from the rider's wallet to the smart contract.

When the rider reaches his destination, it is confirmed by the *confirmRide ()* function of the smart contract. After the call to the *confirmRide ()* function, when the driver ends the trip, the *releaseFunds ()* function is invoked, which again initiates a transaction in the blockchain to transfer the ride fare amount from the smart contract to the driver's wallet.

IV. EXPERIMENTAL RESULTS

We have implemented our ride sharing application on Ethereum test networks. We have used a system with Windows 10 Home, 64-bit operating system, x64-based processor Intel(R) Core (TM) i7-7700HQ CPU @2.80GHz and RAM- 16.00GB (15.9 GB usable). The smart contract was compiled using remix ide and deployed to the RINKEBY test network of Ethereum, using infura API. Table I shows the gas required for each key procedure and the corresponding values in INR. We can see that the initial contract deployment attracts around 77 INR. This is the highest value among all. For all other cases cost per transactions are within 12 INR. All the INR values are based on the fact 1 ether= 140810.5 INR as on 21st June, 2021.

Table 1: Gas fee table for each transaction

Function	Gas fee/ Transaction (ETH)	INR/ Transaction
Contract creation/ deployment	0.0005516	77.81
initialize	0.0000903	12.74
fundRide	0.00003013	4.25
releaseFunds	0.00004187	5.91

V. CONCLUSION

In conclusion, this paper presents a framework for developing a decentralized ride sharing application. This application can serve as a platform to connect the riders directly with the drivers. This concept maintains transparency between the two peers and also there is no involvement of third-party commission, which is further profitable as the entire ride becomes cheap. Also, the use of blockchain to carry out transactions provides an extra layer of transparency and high security of the users' monetary data. Using this application, any user can behave as a rider or a driver based on his current needs. If the person wants to drive to some place and seeks to earn some money on the way, then he can choose to be a driver and if he wants to ride to some location and needs some company, he can opt for the rider option. This also helps people socialize and saves transportation costs and the environment at the same time.

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