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Blockchain Based Car Rental App

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Abstract – *A huge surge is observed in the carpooling industry in the past few years, as it frees commuters from the tyranny of driving a vehicle and later saves them from the rat race of finding a parking spot. Currently, the industry is using a centralized database servers, which exposes the system to hacking and leads to data leaks and compromises the security of the system. A centralized system also opens the possibility of the owner misusing data. As the emerging Blockchain technology offers us total anonymity along with transparency across the database, data security and traceability could be assured throughout the server. The proposed solution aims to develop and put into use a peer-to-peer car-sharing application based on blockchain and smart contracts. For the execution of the smart contracts, Solidity programming language is used. The ecosystem is built using Ethereum blockchain. The main innovation of the paper is to move the existing industry from a centralized to a decentralized ecosystem. Creating a peer-to-peer (P2P) car-sharing application would result in eliminating the middle man, reflecting reduced cost and exposure to data theft.*

Key Words: **Blockchain, Car-Sharing, Smart Contracts, Peer-to-peer (P2P), Solidity, Ethereum**

1. INTRODUCTION

The world is facing a major problem, air pollution. Major cities from various countries have reported low air quality index. Studies conducted in many metropolitan cities have shown that the main reason behind the dropping air quality index is the increasing the number of private vehicles. IQAir studies have shown that the environment in Delhi, the capital of India is not only unhealthy but hazardous. This has many reasons but the main reason is vehicles. Petrol and diesel-powered vehicles generate a lot of hazardous gases and this is the main source of pollution. The suggested fix to this situation is car sharing, this would reduce the number of vehicles and also help reduce traffic. Studies have shown that Americans heavily on automobiles. As the chart shows that majority (76 %) of Americans travel alone. This increases the number of vehicles on street and results in congestion during the peak hours of travel. Moreover owning multiple automobiles also increases the cost of living. Car sharing provides the privilege of not driving to work and having a peaceful journey. It also provides the flexibility to not buy a car out of need and one can continue with their fiscal planning.

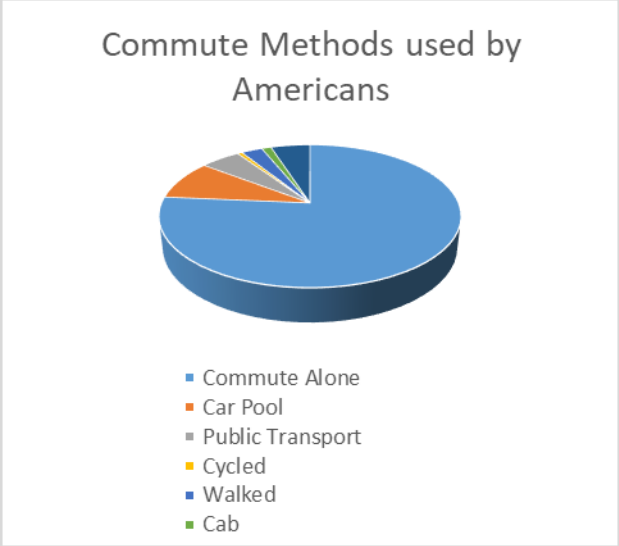

Chart -1: Commute Methods Used by Americans

This concept is not novel, and our writing on it is not the first. The idea struck us while brainstorming various real-life applications of blockchain technology. Various major firms trying to adapt to the concept of peer-to-peer car sharing. A few have aced the ideology and one of the biggest corporations is Lyft a USA-based listed company founded in 2012. Their motto was to make travel more affordable and cities more habitable. The basic idea behind all this is the users could make some money while not using their cars and riders could save a ton of money by not having to buy a car immediately. Unfortunately, offering users this kind of service comes with many security threats; the overall stability of the service is the first. DDoS assaults on a centralized server would lead to the entire service server failure. In contrast, it is nearly impossible to compromise the service when data are pooled and processed over an entire network of nodes, such as in a blockchain.

The traditional data reservoirs also give access to the users to use CRUD operations, which gives the user to create, read, update or delete data. These actions can be done without notifying other users. This kills this transparency aspect of the system. On the other hand, as an irreversible, public ledger, blockchain is, it only permits data creation and reading. Also, each user transaction is displayed to each user irrespective of their presence in that particular transaction.

Additionally, by leveraging the public ledger, we may reduce the costs required to pay vehicle-sharing personnel like system administrators.

All of the aforementioned reasons are what led to the decision to use Flutter Dart as the client side of a decentralized peer-to-peer application that was created on top of the Ethereum network. We are employing Ganache Truffle servers and the MetaMask Wallet as a bridge to the Ethereum network. As previously noted, we did not, however, come up with the notion to develop a peer-to-peer car-sharing platform.

2. BACKGROUND WORK

There is always a middleman ready to take a tiny commission every time a customer considers renting a car or providing their car on hire.

We decided to build a platform for our app that would eliminate the middleman and not charge either party any kind of commission for renting out or providing their cars for rent. We came up with the concept of decentralizing our application to tackle this. We must employ blockchain technology to achieve this.

2.1 DApp (Decentralized Application)

A decentralized application functions on a blockchain system that may function independently, typically using smart contracts. Blockchain technology is a system that uses a peer-to-peer network to preserve a record of transactions across all systems linked to the network. The main goal of this project is to create a system without a middleman that would enable clients to hire automobiles or owners to rent out their cars without having to pay a commission. Both the car owners and the client who wants to rent the cars will be able to look up the locations on a map within the radius they have entered. This will simplify the process and enable the removal of rentals in remote areas.

2.2 Application of Blockchain

A personal blockchain called Ganache is used to create Ethereum applications quickly. Developers can build, deploy, and test their dApps with Ganache across the whole development cycle in a secure and predictable environment.

2.3 Transactions

Our client transactions, which include all kinds of useful information including the transaction id, dates, values, receiver id, and sender id, were completed using Ganache and were stored in a public ledger. Then, all the non-objectionable information is kept in a centralized database (in our case, FireBase). Smart contracts are then used to store the transactions. To conserve space and make the best use of blockchain technology, we have made an effort to keep the transaction blocks as distinct as feasible. Hence keeping our block as light as possible would promise portability.

2.4 Login Authorization

Given that everybody has several accounts on dozens of websites in the internet age, we decided to use a mobile number and One Time Password (OTP) verification instead of password authorization.

2.5 Google Maps API

A crucial component of any application is the user interface. In this instance, Google Maps has been integrated so that we can serve our clients with a user interface that allows them to access Google Maps and search for cars the within specified radius. It requests the user's permission to access the current location.

2.6 Methodology

After considering all the phases, modules, and features that needed to be created and tested for this project, as well as the numerous features that relied on other modules, we chose the Agile development process model. Since the incremental method of project management and product development is structured and iterative. The incremental model divides requirements into numerous distinct modules throughout the software development cycle. The processes of requirements, design, implementation and testing are applied to every module in this paradigm. One of its key advantages is the capacity to adjust and change at any stage and to supply the market with only pertinent products. In addition, the client has access to numerous project iterations and reviews the work at each stage.

3. REQUIREMENTS

3.1 Functional Requirements

a. Login and Signup via Phone Number authentication using OTP.

b. Users can select their destination and number of days for renting the car.

c. They can choose from a variety of cars available for rent.

d. Users can complete payment via their MetaMask Wallet.

e. Users can add their cars and rent them.

f. Users can check their ride history as well as their car's rent history.

g. Users can check and edit their profiles.

3.2 Non-Functional Requirements

a. Security: Verification and Validation of input. Phone a. Authorization for users and storing Transactions in Blockchain.

b. Performance: We have used flutter dart which is faster in response and takes less rendering time.

c. Usability: By designing a user-friendly interface, the end users will be able to rent cars.

d. Availability: The system will be available 24/7 to users with an internet connection.

e. Reliability: The application is highly reliable as it uses all the ACID properties of DBMS and stores transactions in Blockchain so that no transaction will go wrong.

4. USER INTERFACE

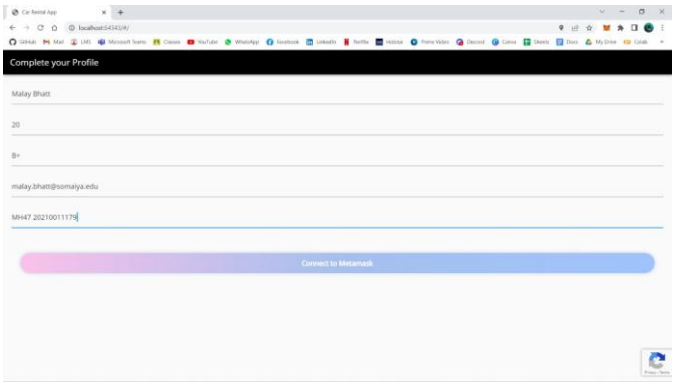

Fig -1: Registration Screen

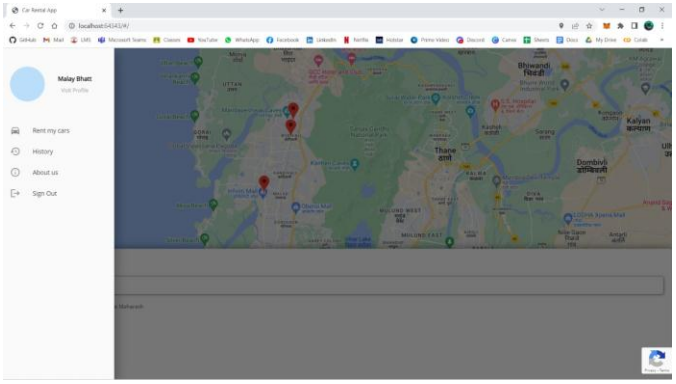

Fig -2: Home Screen

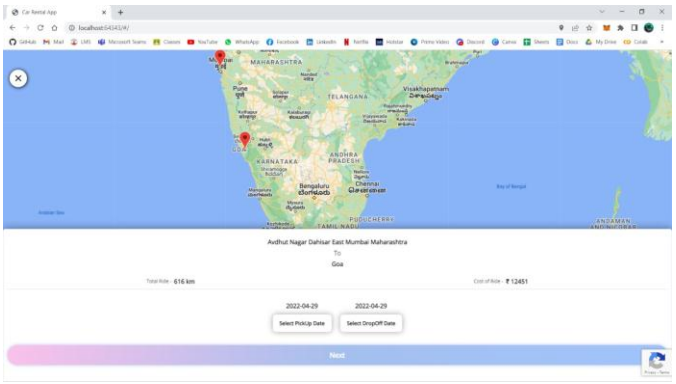

Fig -3: Google Maps API

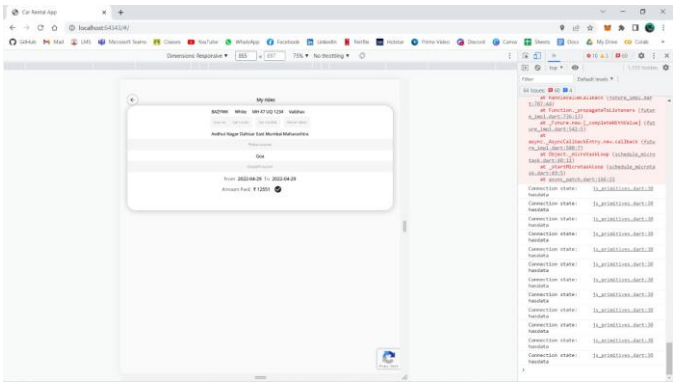

Fig -4: Transaction Receipt

5. TESTING

We prepared two test cases to ensure that our application was functional after the implementation process. The major goal was to assess the overall functionality, speed, and stability of our proposed approach.

Our testing environment included a Dell Inspiron 5570 PC running Windows 10.0.19044 Build 19044 on an x64 architecture, the Chrome web browser with JavaScript enabled, and the MetaMask plugin installed. For easy contact with the Ethereum network, there is MetaMask. We did not activate smart contracts to the main network or any test networks for testing purposes. Instead, we used Ganache to build a local Ethereum network. A one-click personal Ethereum blockchain is called Ganache.

6. RESULTS

In the first scenario, a new car is created and made available for rental, along with an unlock token for the user. Every transaction on the blockchain network requires user payment. The purpose of this test was to determine the actual cost a user would incur to make a vehicle available for rental. We can also think of this sum of money as the user's initial investment in listing the car. The procedure of making a new car is fairly simple. We only open a web dApp, use MetaMask to join into the network, and complete the form by entering the name, description, and image of the car. The entire scenario can be finished in about 15 seconds thanks to its ease of use and simplicity. The cost of using the produce vehicle token function is around 0.00042 ETH.

In the second scenario, we evaluated the application's response time. Our test encompasses the entire process of opening an application, opening details with a car, and receiving an unlocking token. We were curious as to how long it takes to rent and unlock a car. Our application needs to pass this test because one of our goals is to provide a seamless user experience. If the test scenario takes too long, the user might get impatient and exit the app right away. However, based on outcomes, using the application for car

rental is simple and straightforward. The average time to buy a rent token is 14.66 seconds, as shown in Table I.

Table -1: Test results of time needed for renting

Test Run Number	Time
Test 1	13.4
Test 2	14.5
Test 3	16.2
Test 4	12.1
Test 5	10.6
Test 6	12.9
Test 7	12.8
Test 8	11.6
Test 9	15.3
Test 10	14.9
Test 11	16.8
Test 12	15.3
Test 13	19.6
Test 14	16.5
Test 15	17.4
Average:	14.66

7. CONCLUSIONS AND FUTURE WORK

Our primary aim was to design a decentralized peer-to-peer car-sharing system. Through the development of decentralized and immutable blockchain technology, we were able to address issues that centralized services were having with things like denial of service and data mutability. Our method increases ecosystem security by first leveraging blockchain. Even the pupils who don't have access to a car can take public transportation to school or on excursions. This method will enable you to rent a car at your convenience with a variety of alternatives, including the opportunity to rent your vehicle. We have developed a web application that is user-friendly, popular, and easily accessible. Test scenarios suggest that it is fairly simple to create a car that is offered for rental. Additionally, customers can rent a car in 14.66 seconds on average, providing a similar user experience to that of a centralized car-sharing system. But better and more secure without any kind of cyber threat of data theft

In the future, we can use the Flutter App to build a mobile-based application. Web applications are used less regularly than Android apps. Users would benefit and find it more useful as they wouldn't have to open any browsers. In terms of features, functionality, and security, they would be more advanced. Regardless of the fact that our program currently only accepts Ethereum, we can accept multiple cryptocurrencies. Users would take advantage of new crypto enhancements for transactions.

ACKNOWLEDGEMENT

The authors can acknowledge any person/authorities in this section. This is not mandatory.

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