International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

EtherRent: A Co-operative Car Rental Platform

Akhilesh Nair[1], Nelson Chacko[2], Rihab Kasim[3], Ani Sunny[4]

[1,2,3]*Student, Department of Computer Science and Engg, Mar Athanasius College of Engineering, Kerala, India*
[4]*Professor, Department of Computer Science and Engg, Mar Athanasius College of Engineering, Kerala, India*

Abstract - *Today, to attain sustainability of resources, people are trying to promote car-pooling and car rentals to avoid unnecessary carbon emission. Also, it helps the people in providing a source of income and also a facility to the needy. Car rentals are more feasible on a large scale basis because it has no limit to usage or the area of coverage as the constraint. The cars which are being unused by the user can be put to welfare by making it available for people in need of a vehicle. A platform is set up using a blockchain where the owner of a car can enter his or her car credentials, from which the customers could choose the one readily available. The whole transaction is peer-to-peer due to which no third party is involved during a transaction but an automated system governs it. The system also involves automated data collection about car usage in real-time data using IoT sensors. These data make the car availability and usage more authentic and more reliable for both sides of a transaction.*

Key Words: **smart contract, blockchain, car transparency, Internet of Things, Public Ledger, Real-time**

1. INTRODUCTION

For generations, even though there have been a lot of innovations coming up in the field of car manufacturing, there would be control over the number of cars we could see on roads. This may be due to various reasons such as traffic inflation and various kinds of pollution. People in cities and towns prefer public transports rather than personal vehicles. In such a scenario comes the importance of car rentals. Using this facility we could limit the number of cars on the road and also make it available to people in need. It may happen that after a person buys a car, he or she, may not use it the entire time. So giving it on rent could be beneficial for both owners and the consumers. Moreover, it seems more profitable financially to rent a car for people rather than own one.

Today, we are in the digital age. We could see everything, access everything and possess this power while relaxing at our couches at home. These computers are evolving in size and power in various ways. The Internet of Things is an imminent example. Everything is connected to a network from where it could work remotely or even locally. There is also a boon called software development that creates a platform for almost anything. Even to get a haircut, there is a platform to contact a hairdresser effortlessly. In the field of car rentals, many such platforms like Uber, Ola and ZoomCar have flourished in recent times. Even though such advanced technologies are available, there remain various setbacks which need to be worked on like lack of automation, lack of trust and most importantly the ill-effects of centralisation.

The main problem residing in the present rental system is the presence of a third party or the middleman. This middleman charges commission for the car rental, from both the owner and the consumer. So, any rental could happen only if this middleman is present. This problem could be easily solved by using a distributed peer-to-peer network. In such a network, all these transactions occur between the car owner and the consumer and so it significantly reduces the commission rates. This way it would also bring faith in this system which could lead to more people making their cars available for rental. Now a problem may arise as it questions the trust and security of the car we are dealing with because we do not have a central authority to verify and check all details and car condition. This is where smart contracts come into play.

In this paper, we would discuss how using Blockchain-IoT we could automate this service and bring revolution in the field of car rental.

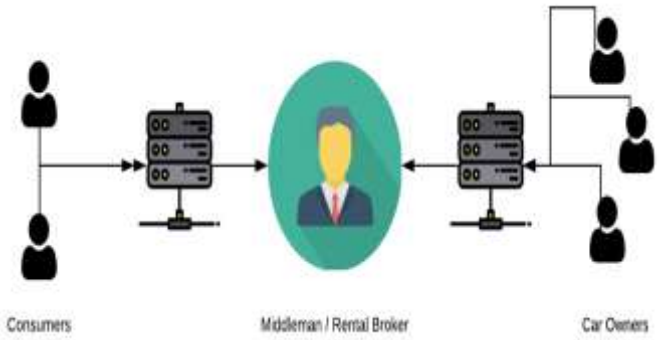

Fig -1: Traditional Rental System

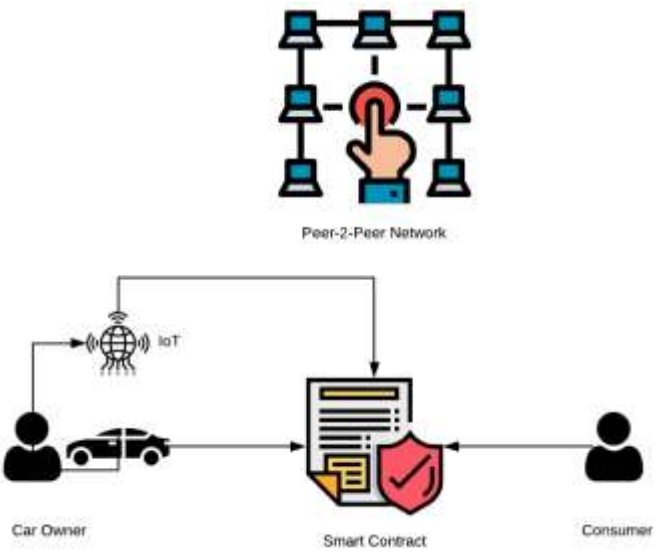

Fig -2: Proposed Rental System

2. DRAWBACKS IN CURRENT SYSTEM

In this section, we bring light on the major drawbacks in the current car rental systems in the market.

1. **Centralization**: Middleman plays an important role in the present car rental system. They set up an office and administrate all the rentals happening through them. They have no real role. They collect the cars from their owners and fix a rent for them. They have a complete control. This was they collect the high rate of commission from both the owner and the consumer. Either way, it's the middleman in profit. Large established companies try to get rid of small rental ventures from the market. They collect all necessary documents from the user which could be sold to others in the market for more unethical profit. As there is no proof of confidentiality, nobody could sue them.
2. **High Commission Rate** These business portals have a high rate of growth compared to other industries. The main striking reason is that these companies do have any resource at risk of loss or damage. They just act in the middle and charge a high rate of commission just to make this transaction happen. Such a service causes a huge loss to the real owners of cars and also the customers who rent from them. This large amount of money is the massive source of income for them with nothing at stake. The commission charges range to about 30\%[4].
3. **Security Reasons** In the present system, there is no guarantee for the car given for rent or any safety assurance for the person renting the car. They both are at their risks. If something happens to the user, its completely up to him. If something happens to the car, it goes straight to the insurance companies and penalty from the user who damaged it. The company does not take responsibility for any of it.
4. **Lack of trust**: There is a genuine lack of trust in the rental business. The consumers have to pay the large amount to the company in one complete transaction itself and yet they miss out various clauses int contract they agree to while taking the car in rent. Considering the case of the owners, the companies could misuse the car as per their requirement and are not answerable to the real owners. They might also disagree to pay service charges or renew their papers when needed [5].
5. **Zero transparency**: Transparency means that everything is visible to everyone, including the source code of the software. In car rentals, they include details about people responsible in a transaction, car documents and people's identity proofs, reports, etc. In the case of an example like zoom car, there is a lack of transparency in terms of documents or reports handled by them.

2. TECHNOLOGY INCORPORATED

As we can see, there are a lot of drawbacks in existing car rental platforms. Each of them can be solved using blockchain-IoT and smart contracts.

The problem of trust can be solved using **blockchain** [6]. Once a transaction is recorded into a block, then nobody can easily interfere with it because each block has a hash value computed from the hash value of the previous block[7]. So if a transaction has tampered, then all upcoming block hash would have to be recomputed which in turn would require a very high amount of computational power. Blockchain is working in a decentralized environment, so basically the middleman is out of the equation. All the important documents will be cryptographically secured on the network. So, all these personal details of users will remain confidential and would not fall into the hands of other business dealers[9]. This could lead to less spamming of the user on the platform. All these transactions will be added to a blockchain, which is like a public ledger book[10]. This means all the transactions are going to be transparent to people using the platform. Blockchain will employ a lot of people in the form of miners who will get paid in the form of transaction fees, which is a lot less than the existing commission.

Smart contracts here will act as the automated centre of authority which checks whether both sides agree to all the terms and conditions. Money, in the form of ethers, are collected from both parties and locked until the car and the user returned safely which then decides that transaction is completed successfully.

The **Internet of Things**(IoT) will aid security purposes. Real-time sensors such as photo-interrupter, GPS and fuel gauge will be used to tackle whether the consumer abides by

the smart contract they signed. If they violate any of the agreement, the sensors would activate the smart contract and the consumer has to pay the penalty for the same. This will ensure more security than the existing platforms.

3. SYSTEM DESIGN

The basic data structure used in this project is the blockchain, which is a growing list of records called blocks. Blocks in our blockchain will represent the transaction made during the renting of the car. All these blocks are linked using cryptography [11]. Each block will have data stored in the form of Merkle trees. It is a tree structure in which each leaf node is a hash of a block of data, and each non-leaf node is a hash of its children [13].

The Merkle tree has up to 2 children on each node, i.e., the balancing factor is 2. This technique provides a security measure against unwanted modification of data by hackers. The hashing algorithm used here is SHA-256 [14]. Here the information data is broken down into pieces of 512 bits (or 64 bytes) and is cryptographically mixed to get a 256-bit hash code. The algorithm consist of a series of simple mathematical steps repeated 64 times. The SHA-256 algorithm is based on the Merkle-Damgard construction method, according to which the initial index is divided into blocks immediately after the change is made, and those, in turn, are divided into 16 words [15].

All transaction will take place in a distributed network where the miners will be paid a small fee. These mining fees will be in the form of ethers on each transaction on the network. The mining fees will be very less compared to other car rental platforms [16].

We will use Proof of Work to achieve consensus. A Proof-of-Work (PoW) system is an economic measure to deter denial of service attacks and other service abuses such as spam on a network by requiring some work from the service requester [11]. The miner will have to calculate the hash value such that first D (difficulty) characters of the hash are '0' [17]. Whichever miner is the first one to generate this hash value and add it in block to the blockchain, will get the fees.

The IoT devices used here include GPS module, Speedometer and Fuel gauge. These sensors will capture real-time data and track the usage of the car by the consumer. It will store data such as distance travelled, top speed reached, accidents, etc. and will create a report on the condition of the car which will also be stored in the blockchain [18]. Any user who wants to rent the car can see the details about the previous usage of the car and how maintained the vehicle is. The user may also check the physical conditions of the car before renting it. If they mutually decide to rent the car, then transaction begins.

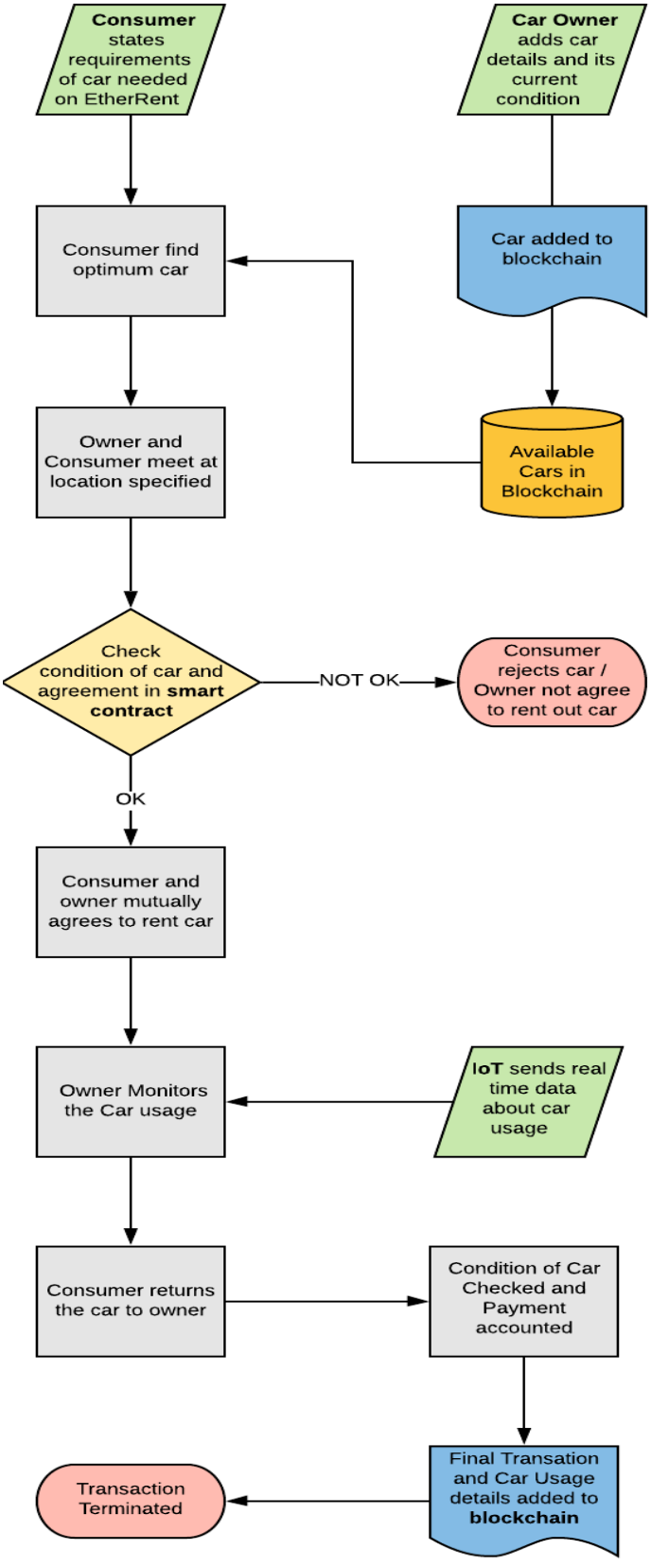

Fig -3: Steps in Car Rental

The smart contract will also monitor the ride and detects any accident using sudden variations in values of GPS and speedometer values. If any accident or any mishap occurs, it would inform the car owner and it would directly inform the emergency control room to bring necessary medication and assistance without any delay.

There are two types of blocks in our blockchain. First is to add the car details from each owner, Second is after a rental completes and whole transaction details to be documented. Both are stored as a separate block in our blockchain. First, the user adds his car specifications and present condition. Then he pens down all the terms and agreements that the consumer must follow wile e rents the car like, how much distance could he maximum travel? What is the maximum speed he could drive-in? What is the fuel level he should maintain during the entire trip? and so on. All this will be in the form of a Smart Contract which will get executed based on the information from the IoT devices fitted on the vehicle [19], [20]. Both partied will mutually decide the price of the transaction which will then decide the fees for the miner to add in the blockchain. Finally, when the consumer returns the car to the user, the smart contract checks if all the given constraints and agreements are fulfilled. Then the transaction is finalized and both parties get payment in respective accounts. All these usage details and transaction details will be added into the blockchain and then a rental is declared complete.

3. ALGORITHMS

In this section, we present the algorithm of our smart contracts which would be running on our platform.

In algorithm 1, we input all the required information about a car to be made available for rental. They include Registration Number, important documents, latest images of the car, account details of the owner, the rate at which it can be rented and the security deposit. The car then will be made available for users to rent.

```
Function Contract1();
    Input Car Registration Number;
    Input Owner account;
    Input model number;
    Input documents;
    Input Images of Car;
    Input Rate;
    Input security;
    Increment the total car count;
    status = Available;
    Init usage_statistics;
End Function
```

Algorithm 1: Adding a car in blockchain

In algorithm 2, we deal with how a car will be booked. So, we ask for client information such as his identification proof and account details. Then, he would choose a car and select the duration for which he wants to rent the car. The total rent amount is calculated and shown. If the car chosen is available and consumer is ready to pay the rent, the car will be hired by them. The total rent and security amount will be deducted from the client's account.

```
Function Contract2();
    Input id of car to be rented;
    Input consumer account;
    Input Start date of rent;
    Input End date of rent;
    Input Client ID proof;
    calculate Rent = total duration * rate;
    if status = Available and Rent = payable then
        Withdraw (rent + security) from consumer
         account;
        status = hired;
        Decrement total car count;
    end
End Function
```

Algorithm 2: Booking a car

In algorithm 3, we handle how to terminate rental. We update all IoT data as car usage statistics in its log. We also update the images of the car after the rental. Then, we make the car status available for others to view and rent.

```
Function Contract4();
    Update usage_statistics;
    Update images of Car;
    Increment total car count;
    status = Available;
End Function
```

Algorithm 3: Ending a Rent

In algorithm 4, we take various parameters as input to our smart contracts such as stating location, finishing location, maximum distance allowed to travel, maximum time limit, top speed permissible and the fuel level to be maintained in the car. We also define a fine value to be paid by the consumer if an agreement is broken or not fulfilled. Real-time values from various IoT devices will be used to achieve the usage statistics. These include GPS for location identification, fuel gauge for fuel limit, Photo-interrupter to calculate speed and distance travelled by car. The final rent amount will be fixed and collected from the consumer at the beginning of itself. A small security deposit will also be collected which will be returned only after successful completion of rent. In the end, the smart contract will check if car exceeded its speed limit or if it travelled distance more than stated in the agreement or if it fuel level has gone down or time limit exceeded. If any kind of violation occurs, it is notified straight to the owner and a penalty will be deducted from the security deposit for the repeated violation. All these details will be encrypted and added to our blockchain at the end of the transaction. A small fee will be deducted from the

Final_Price to pay to the miners who added the transaction to the blockchain. This fees will be very less compared to commission tagged by middlemen.

```
Function Contract3(startLoc, duration
 endLoc, distance, fuelval, maxSpeed, Fine);
    Init: Current_Location;
    Init: Fuel_Limit;
    Init: Odometer;
    Init: Speed_Limit;
    Init: Time_Limit;
    Init: Final_Price;
    Init: Security_Fees;
    if rent mutually agreed then
        Save Final_Price from the user;
        Save Security_Fees from the user;
        trip = start;
    end
    while trip != end do
        if Odometer ≥ distance then
            penalty = (Odometer - distance) * Fine;
            Send Current_Location to Owner;
        end
        if Speed_Limit ≥ maxSpeed then
            send Notification to Owner: Speed Limit
              Crossed;
        end
        if Fuel_Limit ≥ fuelval then
            send Notification to Owner and user: Fuel
              Level Down;
        end
        if Time_Limit ≥ duration then
            penalty = (duration - Time_Limit) * Fine;
            send Notification to Owner and user: Speed
              Limit Crossed;
        end
        end
        Transact Final_Price to Owner;
        Transact (Security_Fees - Penalty) to
         Consumer;
        End Function
         Encrypt block using the public key of both
         customer and sender. Block is propagated to
         all the nodes.
```

Algorithm 4: Basic functioning of rental

3. CONCLUSION

In this paper, we present a decentralized platform for car rental application with minimum transaction charges. This platform uses smart contracts, and the ledger will be in the form of a blockchain which is tamper-proof. The proposed platform will employ a lot of people (in the form of miners) and make them earn money by renting out their cars securely, without a need of giving commissions to the intermediaries. The money will only be transferred to the respective parties on successful completion of the transactions unbiased (judged by the unbiased smart contract). There will also be a provision for a security deposit which will be locked by the smart contract, until the successful completion of the ride. Thus we can see how this system can resolve some of the shortcomings of the car rental industry efficiently.

REFERENCES

[1] S. A. Shaheen, D. Sperling, and C. Wagner, "A short history of carsharing in the 90's," 1999.
[2] R. Schollmeier, "A definition of peer-to-peer networking for the classification of peer-to-peer architectures and applications," in Proceedings First International Conference on Peer-to-Peer Computing. IEEE, 2001, pp. 101–102.
[3] statista-The Statistics Portal, "Car rental stats - india," 2018. [Online]. Available: https://www.statista.com/outlook/270/119/car-rentals/india
[4] B. G. Edelman and D. Geradin, "Efficiencies and regulatory shortcuts: How should we regulate companies like airbnb and uber," Stan. Tech. L. Rev., vol. 19, p. 293, 2015..
[5] P. Kamal and J. Q. Chen, "Trust in sharing economy." in PACIS, 2016, p. 109.
[6] V. Hassija, V. Chamola, V. Saxena, D. Jain, P. Goyal, and B. Sikdar, "A survey on iot security: Application areas, security threats, and solution architectures," IEEE Access, vol. 7, pp. 82 721–82 743, July 2019.
[7] Z. Zheng, S. Xie, H. Dai, X. Chen, and H. Wang, "An overview of blockchain technology: Architecture, consensus, and future trends," in 2017 IEEE International Congress on Big Data (BigData Congress). IEEE, 2017, pp. 557–564.
[8] S. Raval, "Decentralized applications: harnessing bitcoin's blockchain technology," pp. 14–16, 2016.
[9] L. Wang, X. Shen, J. Li, J. Shao, and Y. Yang, "Cryptographic primitives in blockchains," Journal of Network and Computer Applications, vol. 127, pp. 43–58, 2019.
[10] R. Maull, P. Godsiff, C. Mulligan, A. Brown, and B. Kewell, "Distributed ledger technology: Applications and implications," Strategic Change, vol. 26, no. 5, pp. 481–489, 2017.
[11] S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," 2008.
[12] E. Staff, "Blockchains: The great chain of being sure about things," The Economist, vol. 18, 2016.
[13] G. Becker, "Merkle signature schemes, merkle trees and their cryptanalysis, "Ruhr-University Bochum, Tech. Rep, 2008.
[14] W. Penard and T. vanWerkhoven, "On the secure hash algorithm family," Cryptography in Context, pp. 1–18, 2008.
[15] R. Merkle, "Secrecy, authentication, and public key systems," Ph. D. Thesis, Stanford University, 1979.

[16] A. Chepurnoy, V. Kharin, and D. Meshkov, "A systematic approach to cryptocurrency fees," in International Conference on Financial Cryptography and Data Security. Springer, 2018, pp. 19–30.
[17] A. Back, "Hashcash-a denial of service counter-measure," vol. 2, pp. 3–6, 2002.
[18] V. Hassija, G. Bansal, V. Chamola, V. Saxena, and B. Sikdar, "Blockcom: A blockchain based commerce model for smart communities using auction mechanism," in 2019 IEEE International Conference on Communications Workshops (ICC Workshops), May 2019, pp. 1–6.
[19] N. Szabo, "Formalizing and securing relationships on public networks," First Monday, vol. 2, no. 9, 1997.
[20] G. Brambilla, M. Amoretti, and F. Zanichelli, "Using blockchain for peer-to- peer proof-of-location," arXiv preprint arXiv:1607.00174, 2016.