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A Survey of Peer-to-Peer Ride Sharing Services using Blockchain

Riddhi Gupta[1], Riya Gupta[2], Sonali Shripad Shanbhag[3]
School of Computer Science Engineering, Vellore Institute of Technology, Vellore

***Abstract*—Ride Sharing has seen a steep rise in popularity in metropolitan cities to avoid wastage of resources, traffic jams and congestions. This gave birth to a whole new trend which ride aggregator services went on to capitalize by providing the option of sharing cabs to its users at a lower price. Although conventional ride sharing methods have proven to be quite effective, there is always scope for improvement in certain fields. This idea of vehicle sharing can be revolutionized by implementing blockchain technologies. Blockchain is a decentralized record where all the information is stored on systems everywhere which can be retrieved and traced freely. There is a mechanism that allows peer to peer transactions and brings the need for third parties to an absolute minimum. The system is no longer trust-based but simply based on concrete proof that exists which is built into the ledger.**

Keywords*— *Blockchain; decentralization; encryption; peer-to-peer; ridesharing; intermediaries

I. INTRODUCTION

Currently, cab service aggregators are using a centralized methodology to carry out their day-to-day operations. The policies, rules and regulations, terms and conditions that both the user and the driver must follow vary from company to company. Furthermore, the booking of cabs requires mediators or third-party businesses to carry out the payment process. With more parties involved, this proves to be problematic with the creation of a lack of transparency. These disadvantages have led to an extensive study of the blockchain technology and subsequently several proposals of ride-sharing architecture built atop the blockchain. This paper aims to compare and contrast between such existent methodologies. The main objective of this paper is to shed light on the various ways in which the decentralized, transparent ideas of blockchain have been implemented and the reasons for doing so. [8] In this work, we have highlighted advantages as well as shortcomings of these methodologies, along with information about how the blockchain modules and concepts are used in different phases of the system.

II. WHAT IS BLOCKCHAIN?

Blockchain is a public, immutable ledger for tracking resources, recording transactions and building trust. Anything asset (tangible or intangible) can be tracked and traded on a blockchain network, with the main advantage being the reduced risk as well as significant cut in costs for all parties. Every sector in every field is built on data. [7] Most businesses operate solely because of the transfer of information, the faster this happens, the better. Blockchain is perfect for the movement of data because it can provide prompt, shared and completely transparent information that will be kept on an incontrovertible ledger that can be retrieved only by those who are authorized to do so. A blockchain network can be employed in the tracking of orders, expenditure, financial records, manufacture and so on. The most important feature of blockchain is that all users share a single view of the truth, so each member can see all the particulars of a transaction from the very beginning, giving members greater confidence while also increasing efficiency and giving rise to a plethora of applications blockchain can be used for. [25] To further reduce transaction time, a set of rules known as the smart contract is stored on the blockchain and executed automatically. It is used to define conditions for transfer, include terms for different bonds and so on.

III. BLOCKCHAIN BASED INTELLIGENT TRANSPORT SYSTEMS

An intelligent transportation system (ITS) is a technology, application, or platform that uses applications to monitor, manage, or improve transportation systems. Data gathering and analysis are critical components of the Intelligent Transportation System. The outputs of the data collection and analysis system are then used to control, manage, and plan transportation.[23] Weather data, road condition data, and other information that can be used for road safety and management can all be stored in an ITS. [14] Real-time weather and traffic information can help prevent accidents and save lives. Traffic control is also a major issue that ITS is addressing, there are other challenges that ITS may address, such as parking management, traffic data collection, and so on. [2]

Intelligent Vehicle Communication and Data Sharing

Intelligent vehicles are aided by their capacity to connect to the internet and process and share data in real time using Vehicular Ad-hoc Networks (VANET), which allow moving IVs to be dynamically linked. [21]

The Intelligent Vehicle Biometric Crediting (IV- BC) protocol allows us to employ blockchain elements such as distributed ledgers, Merkel trees, Hash functions (SHA-256), and consensus mechanisms (proof of work method) to create a more secure environment with user identity awareness. [8]

It is a peer-to-peer networking system that offers a safe and trusted environment for vehicle communication, providing an intrinsic ledger and secure data access. By equipping intelligent vehicles with digital resources such as cloud computing, data storage, traffic guidance, and decision-making, vehicular cloud computing (VCC) has had a significant impact on traffic management and road safety.[24]

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IV. CURRENT RIDE-SHARING SCENARIO

Ridesharing is a facility that arranges one-way transportation on short notice through mobile apps and websites. To make the overall ride more affordable and environment friendly, the system groups users going in the same direction together and then splits the cab fare. [24] The industry is booming, with clients ready to pay on-demand providers for convenience and a lower fee. However, there are challenges too. The identification and subsequent addressal of these challenging factors are of utmost importance to cab service providers, before consumers lose interest.

Challenges in the Ride-Sharing Industry

1. *Cost Problems due to Intermediaries*: The booking of cabs requires third-party businesses to carry out the payment process, vehicle-tracking, etc. Each of these mediators will take a significant fee per transaction. This will not only increase the cost for the passengers but also present a cut in the drivers' salaries.

2. *Insufficient Transparency*: The existing, centralized system is managed by large companies with several levels of employees which remain unknown to both drivers and riders. Owing to the intervention of numerous unknown roles, both riders and drivers do not get any explanation behind abrupt price spikes and changes in company policy. Moreover, the database of all transactions and bookings is upheld by the company itself, making it unavailable to the public, thus unauthorizing any self-verification the riders or drivers might desire.

3. *Lack of Data Security and Privacy Mechanisms*: The company's database is home to a plethora of sensitive data including current location, phone number and home address of all the users. Even though organizations invest large amounts on user authentication and data protection, cases of false identities and data pirates hacking into the database are not uncommon.

4. *Exploitation of Employees by Companies*: Ride-sharing firms are currently facing a labour dilemma, arising from the fact that their relationship with employees is exploitative in nature. Firms are facing numerous lawsuits over their labour practices. [9] Because the entire system is centralized, labour laws are framed solely by corporate executives with no consideration given to the actual employees.

5. *Trust-based Centralization*: As mentioned earlier, the company is the sole proprietor of a vast database of rider and driver information. Credibility and accountability arise from the trust vested by the users in the firm. This also means there is a single point of failure owing to the centralized nature of the organization. In other words, one dishonest employee or a single malicious attack can cause the entire system to collapse.

V. WHAT IS PEER-TO-PEER RIDE-SHARING?

A peer-to-peer ride sharing service enables customers to discover rides extemporaneously, by conferring first hand with neighboring hosts through radio-based interaction. Put simply, peer-to-peer transport services allow drivers (peers) to offer on-demand transport to those in need of a ride (peers) using their private vehicles. [19] Peer-to-peer networks cope with a variety of hosts, for instance private cars and public transportation vehicles. These differing actions have an impact on the agreements and, as a result, the travel options. Apart from the environmental advantages due to the decrease in number of vehicles and thus amount of fuel required, such a system also opens a whole new world of economic opportunities for car owners.

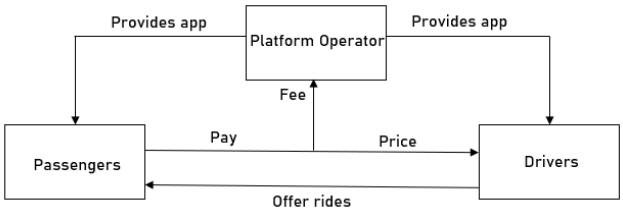

Figure 1- Peer-to-Peer Ride-Sharing Process

VI. APPLICATION OF BLOCKCHAIN CONCEPTS IN RIDE -SHARING

Blockchain based firmware update scheme: Autonomous vehicles manufacturers form a consortium blockchain ensuring high availability and quick delivery of products and updates with low computational cost which is resistant to a DoS attack. [1] Attribute-Based Encryption (ABE) generates an access policy that ensures that only approved autonomous vehicles may download and install new updates while also utilizing a smart contract to assure the validity and integrity of firmware updates. Due to the limited time required for cryptographic computations and the transfer time, the scheme can be implemented during the contact time of two moving autonomous vehicles. [15]

Use of Zero Knowledge Proof Module: In a volatile environment a zero-knowledge proof protocol is utilized. In exchange for proofs of distribution from receiver AVs, each distributor can trade an encrypted version of the update. The smart contract guarantees the delivery of the decryption key, which will be revealed after the proofs are collected. Based on the received proof, the smart contract also increases the distributor's reputation. [15] [16]

Use of Incentives and Rewards: A reward mechanism is designed to incentivize autonomous vehicles to distribute Firmware updates for consortium blockchain by maintaining a credit reputation for each distributor account in the blockchain. [17]

Use of Smart Contract: Consider a Blockchain-based service that provides smart contract templates for drivers and passengers. The two parties will choose a "basic" smart contract template initially (for example, the transfer of goods

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or people; rewarding the driver in fiat currency or cryptocurrency; payment in cash, or through reward points;) The parties will then agree on the transaction's specifics (For instance, the precise fee to be paid; the choice to carry more people or not;) [5] Individuals will no longer require a third party to complete the transaction since the Smart Contract template will ensure that either both sides of the transaction are fulfilled, or none at all.

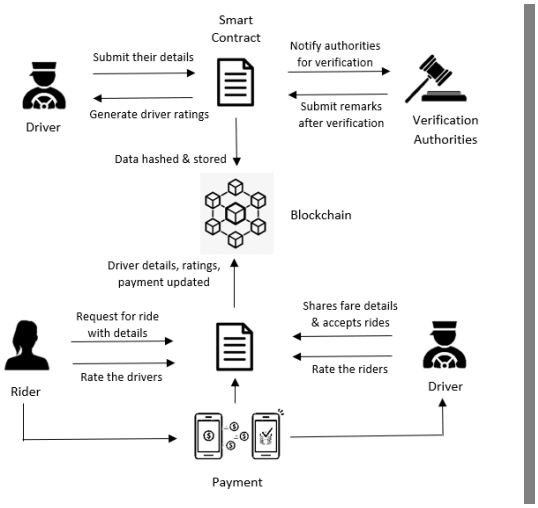

Figure 2- Blockchain based system using Smart Contract

Use of Pseudonymity: Pseudonymity is defined as the usage of aliases (pseudonyms) for confidentiality for the purpose of either shielding one's identity, achieving self-sovereignty, or for privacy and security concerns. [12] Privacy in Blockchain refers to the preservation of anonymity and the unravelling of transactions. Transaction anonymity entails that it is impossible to connect each transaction to a unique user. Consequently, the user makes use of a unique address for every single new transaction. [26] Unravelling makes the assumption that Blockchain addresses and transactions are not linked to the real user identities.

VII. SOME BLOCKCHAIN BASED PEER-TO-PEER RIDE-SHARING ARCHITECTURE

This section is a study of seven of the most popular existent proposals of Peer-to-Peer Ride Sharing Architecture.

1. ***Block-V*** uses a built-in reputation system. In order to assure the fairness of the ride, everything regarding the ride will be permanently written into the ledger, ensuring access to all in the peer-to-peer network. With each account distinctly mapped, it prevents identity theft and when a complaint is lodged, the authorities can verify it by checking the ledger. [4]

2. ***Block-VN*** is a distributed vehicle network architecture. It examines how the network of vehicles evolves with paradigms. The department of vehicles transmits details to the revocation authority each time a vehicle registration is issued. The revocation authority then informs the distributed blockchain of all information about ordinary and miner vehicle nodes. [10]

3. ***B-Ride*** acquaints a reputation model which rates drivers built on prior behavior, allowing riders to select based on the collection of interactions of the drivers. The confirmation is done using zero-knowledge proof to protect rider/driver privacy. To ensure fair payment, a pay-as-you-drive philosophy is presented. [6]

4. ***Green Ride*** promotes social commitments by implementing decentralization where it facilitates carbon emission reduction. It consists of two structures; centralized code that will dwell on Google Cloud App Engine and the decentralized GRTs. It leads to businesses, colleges, and government agencies reducing their annual carbon footprint. [11]

5. ***PEBERS*** is a ride hailing service based on Ethereum. Each user is given a unique ID using which they search for a ride in the blockchain ledger using the fog mechanism. Data is stored based on Distributed Ledger Technology making it decentralized. Consensus Protocol ensures data consistency. [13]

6. ***O-Ride***, a privacy-preserving system optimizes SHE so that bandwidth requirements and processing overhead are lessened using ciphertext packing and transformed processing. It includes features such as credit-card payment, contacting drivers in the event of missing belongings, and traceability in the event of criminal activity. [18]

7. ***Ride Matcher*** is an architecture where clients do not use a central database to find available rides but a peer-to-peer method i.e., forming ridesharing groups online. In this application, a node decides and executes an activity; it searches for a node whose routes match fully. [20]

VIII. MERITS AND DEMERITS OF BLOCKCHAIN BASED SYSTEM

The future of Blockchain technology is very bright. Although it swoops in as a means of resolving pressing matters with the current ride-sharing system, it has a few disadvantages too.

Merits

1. The consensus based, check instrument ensures a permanent, and recognizable blockchain record, which can secure against the double spending without confiding in middle people in a decentralized design. [3] This element sets up a monetary specialty framework in the ITS environment.

2. Guarantees that a malevolent driver can't present various proposals to riders or give a legitimate confirmation to get an area to guarantee the rider's installment or make an unjust remission by time-locked deposit contract, proof-of-knowledge and the reputation system.

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3. Vehicular cloud computing (VCC) significantly influences traffic management and street security by furnishing intelligent vehicles with advanced materials, for example, cloud computing, information stockpiling, traffic management, and decision making. [22]

4. If the information is changed by a hacking attack, the framework will show the block which has been altered and after altered blocks, Blockchain will go to the invalid state. This guarantees greater security and reduces the time to revalidate information. [7]

Demerits

1. Rideshare apps have a history of doing minimal background checks on drivers, but taxi drivers must go through more thorough security screenings that include fingerprinting and identification checks.

2. The blockage of fake requests burdens the organization and correspondence between the sender and the receiver and can turn out to be very hard to maintain. [7]The size of Blockchain data is quite large and therefore it can be a challenge to maintain consistent security and privacy.

3. A fraudulent driver can acquire down-payments without sticking to his/her proposition because the down-payment made by a rider goes directly to the driver once he/she confirms his/her arrival to the pick-up destination.

4. The user accounts are distinctly mapped with the reputation system. This prevents people from being anonymous, i.e., without changing their credibility score and wallet values, they cannot alter their identity.

IX. CONCLUSION

Existing ride-sharing platforms, though effective and popular, still have room for improvement in terms of pricing models, user safety, lack of transparency in transactions and data security. Blockchain enabled systems can help solve all of these issues and offer more innovative functionality with an increased ease of use and management. Riders can connect directly with drivers via blockchain's decentralized network, thus reducing the additional costs. Because there are no intermediaries, folks with a smartphone and secure modern vehicles have more market prospects. Passengers can analyze how a ride-sharing service functions thanks to blockchain's capacity to establish accountability. Smart contracts encourage stakeholders to employ blockchain-enabled peer-to-peer leasing of automobiles for two parties directly involved based on the essential pre-decided specifications. As a result, it provides appropriate pricing every time and the system gains credibility and transparency. The restrictions created ensure that drivers do not engage in any illegal conduct by generating an appropriate ranking for riders. For instance, blockchain technology can be developed to customize auto insurance based on particular data gathered about car usage. Furthermore, statistical studies show that a car stays idle for a significant period of its lifetime. Blockchain offers a way of monetizing the ability of asset owners to use it at a much higher level and monetize transactions.

X. FUTURE WORK

Although there are a few unknowns, blockchain technology has the potential to revolutionize the way existent ride-sharing corporations function. We believe that Ethereum-based crypto-equity can solve the labour dilemma that ride sharing firms are facing, where they have exploitative relationships with their employees and are facing several lawsuits over their labour practices. With decentralization, labour laws could be framed taking into consideration the concerns and ideas of drivers. One of the most unsolvable challenges is transparency in payment. The incorporation of the principles and ideas of bitcoin and cryptocurrency could revolutionize the entire industry with a foolproof layer of added credibility, accountability and reliability.

XI. REFERENCES

[1] Baza, M., Mahmoud, M., Srivastava, G., Alasmary, W. and Younis, M., 2020, May. A light blockchain-powered privacy-preserving organization scheme for ride sharing services. In 2020 IEEE 91st Vehicular Technology Conference (VTC2020-Spring) (pp. 1-6). IEEE.

[2] Yuan, Y. and Wang, F.Y., 2016, November. Towards blockchain-based intelligent transportation systems. In 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC) (pp. 2663-2668). IEEE.

[3] Wang, D. and Zhang, X., 2020. Secure Ride-Sharing Services Based on a Consortium Blockchain. IEEE Internet of Things Journal.

[4] Pal, P. and Ruj, S., 2019, July. BlockV: A Blockchain Enabled Peer-Peer Ride Sharing Service. In 2019 IEEE International Conference on Blockchain (Blockchain) (pp. 463-468). IEEE.

[5] Abuhashim, A. and Tan, C.C., 2020, July. Smart Contract Designs on Blockchain Applications. In 2020 IEEE Symposium on Computers and Communications (ISCC) (pp. 1-4). IEEE.

[6] Baza, M., Lasla, N., Mahmoud, M., Srivastava, G. and Abdallah, M., 2019. B-ride: Ride sharing with privacy-preservation, trust and fair payment atop public blockchain. IEEE Transactions on Network Science and Engineering.

[7] Chang, S.E. and Chang, C.Y., 2018, July. Application of blockchain technology to smart city service: A case of ridesharing. In 2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData) (pp. 664-671). IEEE.11

[8] Xu, B., Agbele, T. and Jiang, R., 2020. Biometric Blockchain: A Secure Solution for Intelligent Vehicle Data Sharing. In Deep Biometrics (pp. 245-256). Springer, Cham.

[9] Zhang, X., Liu, J., Li, Y., Cui, Q., Tao, X. and Liu, R.P., 2019, October. Blockchain based secure package delivery via ridesharing. In 2019 11th International Conference on Wireless Communications and Signal Processing (WCSP) (pp. 1-6). IEEE.

[10] Sharma, P.K., Moon, S.Y. and Park, J.H., 2017. Block-VN: A distributed blockchain based vehicular network architecture in smart City. Journal of information processing systems, 13(1).

[11] Khanji, S. and Assaf, S., 2019, June. Boosting ridesharing efficiency through blockchain: Greenride application case study. In 2019 10th International Conference on Information and Communication Systems (ICICS) (pp. 224-229). IEEE.

[12] Kanza, Y. and Safra, E., 2018, November. Cryptotransport: blockchain-powered ride hailing while preserving privacy, pseudonymity and trust. In Pr4oceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (pp. 540-543).

[13] Kudva, S., Norderhaug, R., Badsha, S., Sengupta, S. and Kayes, A.S.M., 2020, February. Pebers: Practical ethereum blockchain based efficient ride hailing service. In 2020 IEEE International Conference on

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 08, August-2021

Informatics, IoT, and Enabling Technologies (ICIoT) (pp. 422-428). IEEE.

[14] Balasubramaniam, A., Gul, M.J.J., Menon, V.G. and Paul, A., 2020. Blockchain For Intelligent Transport System. IETE Technical Review, pp.1-12.

[15] Baza, M., Nabil, M., Lasla, N., Fidan, K., Mahmoud, M. and Abdallah, M., 2019, April. Blockchain-based firmware update scheme tailored for autonomous vehicles. In 2019 IEEE Wireless Communications and Networking Conference (WCNC) (pp. 1-7). IEEE.

[16] Li, W., Meese, C., Guo, H. and Nejad, M., 2020. Blockchain-enabled Identity Verification for Safe Ridesharing Leveraging Zero-Knowledge Proof. arXiv preprint arXiv:2010.14037.

[17] Rathee, G., Sharma, A., Iqbal, R., Aloqaily, M., Jaglan, N. and Kumar, R., 2019. A blockchain framework for securing connected and autonomous vehicles. Sensors, 19(14), p.3165.

[18] Pham, A., Dacosta, I., Endignoux, G., Pastoriza, J.R.T., Huguenin, K. and Hubaux, J.P., 2017. Oride: A privacy-preserving yet accountable ride-hailing 12 service. In 26th {USENIX} Security Symposium ({USENIX} Security 17) (pp. 1235-1252).

[19] Bossauer, P., Neifer, T., Pakusch, C. and Staskiewicz, P., 2019. Using Blockchain in Peer-to-Peer Car Sharing to Build Trust in the Sharing Economy.

[20] Bozdog, N.V., Makkes, M.X., Van Halteren, A. and Bal, H., 2018, May. RideMatcher: peer-to-peer matching of passengers for efficient ridesharing. In 2018 18th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGRID) (pp. 263-272). IEEE.

[21] Singh, M. and Kim, S., 2017. Blockchain based intelligent vehicle data sharing framework. arXiv preprint arXiv:1708.09721.

[22] Shivers, R., Rahman, M.A. and Shahriar, H., 2019. Toward a secure and decentralized blockchain-based ride-hailing platform for autonomous vehicles. arXiv preprint arXiv:1910.00715.

[23] Lei, A., Cruickshank, H., Cao, Y., Asuquo, P., Ogah, C.P.A. and Sun, Z., 2017. Blockchain-based dynamic key management for heterogeneous intelligent transportation systems. IEEE Internet of Things Journal, 4(6), pp.1832-1843.

[24] Singh, M. and Kim, S., 2017. Intelligent vehicle-trust point: Reward based intelligent vehicle communication using blockchain.arXiv preprint arXiv:1707.07442

[25] Bitcoin and Cryptocurrency Technologies- Draft 2016. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Princeton University.

[26] Jesus, Emanuel Ferreira, et al. "A survey of how to use blockchain to secure internet of things and the stalker attack." Security and Communication Networks 2018 (2018).