Blockchain-Enabled Urban Transportation: A New Era Mobility

Varnika[1], Swapnil Tyagi [2], Aarti Chaudhary , Shikha Agrawal

[1,2] Student, Department of Information Technology
[3,4] Assistant Professor, Department of Information Technology
[1,2,3,4] Ajay Kumar Garg Engineering College, Ghaziabad, Uttar Pradesh

Abstract: *With the help of its decentralization, good performance, and trackability features, blockchain technology has found widespread use in various types of business, containing commerce, transportation, literacy, healthcare, network security, along with management science. We have progressed in contrast to earlier studies on Intelligent Transportation Systems. To introduce this system, an urban intelligent transportation system's fundamental framework has been developed. Blockchain used in underdeveloped nations for transport systems (UITS). In order to build a cutting-edge framework for the large information stage that drives the intelligent transportation, Blockchain technology is used to elaborate in detail the situation of 3 illustrative Intelligent Transportation Systems in China. It also served as a replica for development of the most recent Urban Intelligent Transportation Systems (UITS) in underdeveloped nations.*

Keywords– *blockchain , urban intelligence transportation system , security , developing countries , blockchain internet of vehicles .*

I. INCEPTION

Over the years, there has been an appreciable surge in the number of vehicles. Despite advancements in infrastructure, existing transport solutions have become inadequate to cope with the contemporary traffic congestion issues. Intelligent transport system (ITS) integration is now more important than ever. The main goals of ITS are to improve traffic efficiency, lessen gridlock, and pave the way for smarter roadways. Users are given useful information about traffic conditions and seat availability. As a consequence of this, travel is less dangerous, more comfortable, and takes less time. The concept of VANETs are the (vehicle ad hoc networks) has evolved in a revolutionary plan known as the Internet of Vehicles (IoV), thanks to the expeditious progress of new computer and communication technology.[1][3] The US Department of Transport emphasizes the importance of the Internet of Vehicles (IoV) for creating an Intelligent Transportation System (ITS). This is because it provides the essential basis for connecting smart vehicles to the internet. (DOT) [4], The Internet of Vehicles (IoV) technology consists of the ability to reduce the number of accidents involving unimpaired drivers. Studies show that by adopting IoV, 79% of such incidents could be prevented as effective communication & collaboration between vehicles is enabled. Through the interconnection of several elements such as bicycles, pedestrians, and roadside infrastructure, global traffic control can be enabled. We can lower environmental pollution, accident rates, and traffic bottlenecks by exchanging information about traffic conditions, safety, and accidents. Implementing ITS can significantly improve the comfort, convenience, and safety of both pedestrian traffic and public transportation services.. It is estimated that the installation of ITS will rise substantially in the near future due to projects like ERTICO-ITS Europe [5] and CityVerve Manchester [6], This technology is essential for the growth of smart cities. It enables interconnection between smart vehicles, roadside infrastructure, and pedestrians, thus helping with complex functional requirements of Intelligent Transport Systems (ITS) while enablingUsing a vehicle-to-everything (V2X) strategy. However, it is anticipated that a rising number of smart cars and related services and apps for vehicles would eventually produce massive volumes of data and significant network traffic. In addition, the complicated Internet of Things context, reduced latency, and extensive mobility might lead to issues with cloud storage, administration, and security. As a result, it's essential to guarantee consistency and compatibility of IoV entities employing various service providers.. Consequently, the security, scalability, flexibility, interoperability, distribution, and decentralization of the Internet of Vehicles (IoV) platform need to be guaranteed. This is imperative for the development of IoV and to completely capitalize on some of its most powerful propertiesSince the launch of Bitcoin, blockchain technology has profoundly changed digital currency [7]. A system of distributed ledgers that can permanently record all network transactions is part of this modern decentralized technology. Initially,

Blockchain was mainly used by the finance industry however, recently it has been a topic of conversation amongst the scientific community as they focus on its applications to the IOT for short, and embraced it in order to create a distributed, reliable, and secure ecosystem. By guaranteeing the accuracy of data through agreement, the inviolability of documentation, and contract pellucidity, the emergence of this technology has sparked the rise of technological advances in sensitive and active areas. However, increased security and trust are blockchain's most significant accomplishments. The automation and optimisation of the information handling process as well as cost savings have also been made possible thanks to smart contracts. Blockchain technology is superior to conventional centralized architectures in many ways. However, issues like storage constraints, rigidity, and high prices must be taken into account. More particular, this connection may significantly improve large data storage, security, intelligence, and effective IoV administration..

II. PROBLEMS

Smetanin et al. [8]Their study did not examine how Hyperledger, Ethereum, and Bitcoin were used to build Blockchain. In actuality, the study concentrated on the software domain and ignored outstanding issues. The privacy concerns and important elements in interpersonal IoV (SIoV) contexts were examined by Butt et al. [9]. The authors looked at the elements crucial to SIoV systems' privacy. Safety demands ,objectives, transmission engineering, public ties, user predilection, situational consciousness, and structure are a few of these elements. Note that no other issues were explored; this paper just looked at the privacy aspect of blockchain. Topics pertaining to widespread vocation, commerce, IOT, and believe difficulties haven't been taken into account, according to Astarita et al [10].El-Switi and Qatawneh looked into that According to the authors, it is critical to develop because the market for used automobiles is an important part of the economy with multiple players and an elevated possibility of fraud (such speedometer frauds), it needs a system for tracking and recording vehicle data.. Most notably, this data established the drivers behind why investors manage and maintain the Blockchain; essential seclusion problems were also highlighted; nevertheless, the study did not look at the Blockchain's limitations.A recent advancement in five-generation technology, huge information analysis, or machine learning were not taken into consideration by Wang et al.'s[12] examination of Blockchain-based cybersecurity for vehicle connections or their investigation of IT security threat assessments of vehicular networks.

Author	Year	Objective	Merits	Demerit
Butt et al .[9]	2019	Research on privacy issues regarding SIoV	Discuss all the problems regarding security etc.	only social problems of SIoV are discussed.
Astarita et al.[10]	2020	Application-based study on blockchain-system.	Able to find primary research gaps using multistep technology.	Didn't analysis the IoT, Trust issue, etc.
El-switi et al. [11]	2021	To investigate ongoing research on IoV.	Uncovered incentives to manage blockchain.	Didn't discuss the limitations of blockchain.
Wann et al.[12]	2020	Application of blockchain on cybersecurity on IoV.	Able to recognize the cybersecurity threats.	Didn't include 5G,6G, big data, and ML.

Figure 1 table of advantages and disadvantages of previous work

Now that a single authority is responsible for the problems such as - it is highly dependent on the network connectivity, if the nodes lose communication, then the system can fail. Secondly, there is difficulty in maintaining large data centers and server stations. Thirdly, there is very less chance of data backup. If the server nodes fail and there is no backup, we could possibly lose all of it straight away.

III. UITS WITH BLOCKCHAIN TECHNOLOGY

A blessing for meeting the needs of a transport system everywhere in the globe is the UITS with Blockchain Technology. Blockchain technology's amazing qualities allow for significant ITS improvement. The benefits of blockchain technology, such as security, privacy, interoperability, transparency, decentralization, immutability, distributed, traceability, efficiency, and speed, among others, enable the development of a number of ITS facilities that improve and strengthen the system. Numerous ITS applications, such as secure data exchange, intelligent traffic controlling, connected and automatic vehicle technology, mechanized toll

accumulation, in the flesh driver details, and advanced transport structure, can benefit from the use of blockchain technology.Cloud computing, environmentally friendly computing, fog computing,

AI, IOT and mobile computing are the technologies employed in the development of the ITS. The ITS seeks to improve the transport system's cost-effectiveness and environmental friendliness because the work that has been done in this area thus far has been quite expensive and not economically feasible for the people in society. Additionally, because the development of the transport system has a significant impact on the environment, we must make sure that the development is carried out in a way that the environment is affected. The idea of smart cities, that seeks the transform modern areas into digital areas and make day to day living simpler, has made the ITS a crucial component. In the transportation system with the technology behind blockchain It is possible to create a top-level system design that serves as the framework for the entire blockchain basis intelligent traffic control system and serves a vital uplifting part in the structure. This design includes the prize and penalizing system as well as the credit evaluation system. Users that actively engage in blockchain and post truthful information are rewarded with virtual money under the system's reward and punishment provisions. [14]. Using blockchain technology, a credit evaluation system establishes a secure and trustworthy database that utilizes various query timestamps to aid analytical queries, retains information safety and undeniability and utilizes user trust by examining service trust, behaviors, faith, and task certitude[15,16]. Yang et al. [17] laid out a blockchain-based deconcentrated faith administration structure for automobile connections.

IV. INNOVATIONS IN 2023

The transport sector has already seen a lot of new advancements thanks to blockchain technology. One of the most recent improvements is the introduction of 5G technology.

With the aid of 5G technologies in the transportation network and blockchain. We can improve the precision and effectiveness of the current ITS systems, including the speed limits, pollution controls, and quick responses to accidents, etc., with the use of 5G technology. Traditionally, trackers and CCTVs were used to operate all of these systems, but these systems were slow and ineffective and couldn't handle large amounts of data. Therefore, by using 5G technology, we can effectively manage massive amounts of data.

Since the new vehicles being built are fitted with sensors, cameras, GPS, and other technologies to supply the owners with real-time information on the vehicles, there has been a significant decrease in vehicle theft instances thanks to 5G technology. The characteristics of blockchain, such as security, privacy, secrecy, authentication, availability, integrity, and non-repudiation, have significantly improved with the aid of 5G, creating a very safe and secure environment for transportation systems.

Et al [18]Another hot issue in the new invention ideas is autonomous automobiles.It comprises driverless automobiles, autonomous last-mile delivery vehicles, and autonomous trucks.Despite several pilots and media attention, the question of whether self-driving trucks are sufficiently equipped to enter the road is still up for debate. The growing annual driver shortage is one of the main forces behind self-driving trucks. The driver shortage cannot be quickly solved by driverless trucks, though. In actuality, driverless trucks are not meant to take the role of human drivers, much like automatic robots. They are here to work with drivers to facilitate the process, not to compete with them.

However, more and more businesses are looking into the usage of last-mile drones in an effort to reduce delivery costs while enhancing customer experience. The well-known Platooning appears to be an area where the reality of autonomous vehicles might have an immediate impact. In these approaches, the lead vehicle has technology enhancements, and a follower truck cooperates with it via a completely autonomous system. The trucks are connected to one another and move in a platoon or group with the other vehicles. Each truck still has a driver inside for safety and to take control when the truck exits the motorway. As a result, the following driver may take a break and log off while the vehicle is in motion.This implies that the two vehicles, working together, enable drivers to go twice as far without exceeding the allowed hours of duty.For a multitude of reasons, including FAA restrictions, public opinion, and the technology itself, the employment of last mile drones is still difficult. Wing, Amazon, UPS, Matternet, Flytrex, and Zipline are now available. Each of these businesses has successfully delivered small products using drones to a variety of locales. It continues to appear that using drones to carry prescription drugs and medical supplies has been the most successful.

Automatic mobile robots are the inversion of automatic home delivery. Automatic delivery bots are now being tested by various businesses in cities and on colleges. However, the word "autonomous" may be rather misleading for many of these businesses. In reality, a group of humans is following the car at all times in the delivery process. The human worker can use a remote control to drive or fix the vehicle while the behind-the-scenes staff mostly watches the robot in case it has problems. In addition, these employees will step in to complete the delivery if the robot gets stuck or is unable to do so. Several businesses, including Starship Technologies, Nuro etc, have finished numerous pilot programs and are implementing delivery bots right now. Entrepreneurs have invested more than $8 billion in autonomous delivery startups over the past two years. What does the general population believe about these delivery vehicles?Though the conclusion is yet out on that, the

use of this technology is approaching normality as they grow more widespread, and the number of use cases increases. In either case, it offers a preview of what home delivery may look like in the future.

V. CONCLUSION

Metropolitan administration, freight cops, traffic governing, and inhabitant wander services have all been developed as a result of the development of blockchain, big data, artificial intelligence, and other technologies. Construction in growing nations now also requires a lot of work.

Urban Intelligent Transportation Systems (UITS) for a variety of reasons. The exploration system structures, functions, benefits, and constraints are discussed in detail, along with the current condition of Intelligent Transportation Systems (ITS) building in 3 Chinese cities.

It provides a organizational paradigm for developing a huge-information stage for Urban Intelligent Transportation Systems (UITS) using blockchain technology.This article also builds a top-level design structure model of an Urban Intelligent Transport System (UITS) based on blockchain traffic cloud, which developing countries may utilize as an idea..

The integration of blockchain technology and Urban Intelligent Transportation Systems (UITS) presents a number of difficult challenges, particularly in developing nations. A thorough discussion of upcoming and open research approach is also conducted.

VI. FUTURE WORK

Smetanin et al.[13]Due to the complexity and interconnectedness of ITS, security is an important component of their fortunate establishment and functioning. The following are some essential security demands and chances for the next ITS: Access control and authentication It is essential to make sure that only allowed people and devices may find and connect with ITS structures and information. Applying strong authentication and access control systems, such as multifactor protection and part-basis approach handling, is essential to get this. Data confidentiality and privacy: ITS produces and processes a lot of data, including sensitive and personal data. Encryption and removing identifying particulars techniques are required in order to protect this data from unauthorized access and dispersion. Redundancy and resilience: ITS systems need to be able to be unaffected by a variety of lack of success and threats, such as cyberattacks, natural catastrophes, and equipment faults. Applying superfluity and ancillary systems, as well as ongoing testing and surveilling, are necessary for this.Compatibility and uniformity: ITS involves numerous devices, systems, and participants, making internetworking and substitutability important for ensuring secure and efficient information exchange and communication. Security processes that include coordination among many investors, such as individuals from business, government, and higher education, are crucial for identifying and highlighting possible security flaws and challenges given the intricate and interwoven nature of ITS. Future ITS security may include the application of cutting-edge technology like blockchain and artificial intelligence to improve security and privacy. While AI can assist in the flesh detection and mitigation of security risks, blockchain can offer a secure and transparent method of data storage and exchange. In addition, including security by design principles in ITS creation and development can help guarantee that security is a built-in feature rather than a secondary consideration.

REFERENCES

[1]. Sudeep Tanwar, Sudhanshu Tyagi, Ishan Budhiraja, and Neeraj Kumar. Tactile internet for autonomous vehicles: Latency and reliability analysis. IEEE Wireless Communications, 26(4):66–72, 2019

[2]. Surbhi Sharma and Baijnath Kaushik. A survey on the internet of vehicles: Applications, security issues & solutions. Vehicular Communications, 20:100182, 2019.

[3]. Yueyue Dai, Du Xu, Sabita Maharjan, Guanhua Qiao, and Yan Zhang. Artificial intelligence empowered edge computing and caching for internet of vehicles. IEEE Wireless Communications, 26(3):12–18, 2019.

[4]. Ayyoub Lamssaggad, Nabil Benamar, Abdelhakim Senhaji Hafid, and Mounira Msahli. A survey on the current security landscape of intelligent transportation systems. IEEE Access, 9:9180–9208, 2021.

[5]. ERTICO – ITS Europe. https://ertico.com/, 2021. [Online; Available].

[6]. cityverve. https://www.smartsustainablecities.uk/cityverve, 2021. [Online; Available].

[7]. bitcoin.org. https://https://www.bitcoin.org/, 2021. [Online; Available].

[8]. S. Smetanin, A. Ometov, M. Komarov, P. Masek, and Y. Koucheryavy, ''Blockchain evaluation approaches: State-of-the-art and future perspective,'' Sensors, vol. 20, no. 12, p. 3358, 2020, doi: 10.3390/s20123358.

[9]. T. A. Butt, R. Iqbal, K. Salah, M. Aloqaily, and Y. Jararweh, ''Privacy management in social Internet of Vehicles: Review, challenges and blockchain based solutions,'' IEEE Access, vol. 7, pp. 79694–79713, 2019.

[10]. V. Astarita, V. P. Giofrè, G. Mirabelli, and V. Solina, ''A review of blockchain-based systems in transportation,'' Information, vol. 11, no. 1, p. 21, Dec. 2019.

[11]. S. El-Switi and M. Qatawneh, ''Application of blockchain technology in used vehicle market: A review,'' in Proc. Int. Conf. Inf. Technol. (ICIT), Jul. 2021, pp. 49–54.

[12]. X. Wang, C. Xu, Z. Zhou, S. Yang, and L. Sun, ''A survey of blockchain based cybersecurity for vehicular networks,'' in Proc. Int. Wireless Commun. Mobile Comput. (IWCMC), Jun. 2020, pp. 740–745

[13]. Debashis Das, Sourav Banerjee, Pushpita Chatterjee, Uttam Ghosh, and Utpal Biswa "Blockchain for Intelligent Transportation Systems: Applications, Challenges, and Opportunities"

[14]. L. Zhang, M. Luo, J. Li et al., "Blockchain based secure data sharing system for Internet of vehicles: a position paper," Vehicular Communications, vol. 16, pp. 85–93, 2019.

[15]. A. Beirami, Y. Zhu, and K. Pu, "Trusted relational databases with blockchain: design and optimization," Procedia Computer Science, vol. 155, pp. 137–144, 2019.

[16]. B. Shala, U. Trick, A. Lehmann, B. Ghita, and S. Shiaeles, "Novel trust consensus protocol and blockchain-based trust evaluation system for M2M application services," Internet of Things, vol. 7, Article ID 100058, 2019.

[17]. Z. Yang, K. Yang, L. Lei, K. Zheng, and V. C. Leung, "Blockchain-based decentralized trust management in vehicular networks," IEEE Internet of Things Journal, vol. 6, no. 2, pp. 1495–1505, 2018.

[18]. Top 5 Transportation Technology Trends For 2023 (forbes.com)

Mrs Aarti Chaudhary is working as Assistant Professor in the Department of Information technology at Ajay Kumar Garg Engineering College, Ghaziabad. Her current research interests are in Blockchain, Data Mining. She has presented her work at several national and international conferences and published many articles in Scopus.

Varnika is a second year undergraduate pursuing B.Tech in Information Technology from AKGEC Ghaziabad.She is a tech fanatic person and is eager to learn new technologies. She is proficient in front end development and has a knowledge of C language, Java and python. She has a passion for problem-solving and is always seeking out new challenges and opportunities. She aims to build a start-up in the future with an innovative idea.

Swapnil Tyagi is a 2nd year undergraduate pursuing BTech in Information Technology from AKGEC Ghaziabad. He is a person who is very hardworking and a fast learner. He is very fond of exploring new technologies and working with them.He has a knowledge of many languages like C,C++ and python also he is a blockchain enthusiast. He wants to work with a product based esteemed organization in future.

Mrs Shikha Agrawal is pursuing PhD from Amity University, Noida. She is working as Assistant Professor in the Department of Information technology at Ajay Kumar Garg Engineering College, Ghaziabad. Her current research interests are in Blockchain, Cloud Computing and Network Security. She has presented her work at several national and international conferences and published many articles in Scopus.