© December 2022 | IJIRT | Volume 9 Issue 7 | ISSN: 2349-5162

Use of block chain technology to improve and enhance urban governance: A Critical Review

A. Varun V. Nair[1], B. Ankita Srivastav[2] and Varsha Khetrapal[3]

[1]*Student,* [2]*Assistant Professor,* [3]*Associate Professor, Dept. of Planning & Development, Sushant University, Gurugram, India*

***Abstract*— Urbanization is the progressive growth in the number of people living in urban regions, the population movement from rural to urban areas, and the adjustments made by each society to this transition. It is primarily the process by which towns and cities are created and enlarge as more people move into urban centers to live and work. This is where the idea of a smart city is introduced. A smart city is, in general, a community that makes use of technology to deliver services and address urban issues. A smart city enhances social services, promotes sustainability, and gives its residents a voice. It also works to make transportation, accessibility, climate etc. better. The least amount of human intervention is required for all of these. At that point, urban governance becomes seamless and effective. To do this, we should employ quick and improved technology to meet the needs of a smart city and enhance the quality of life for citizens. One such technology that can meet the new and growing expectations for a smart city's efficient and seamless operation is blockchain technology. The reduction of expensive and time-consuming operations is one of blockchain's primary benefits**.

***Index Terms*—Artificial Intelligence, Blockchain Technology, Decentralization, IOT, Meta Health, Smart Governance, Smart City, Urban Governance.**

I. INTRODUCTION

"I view a smart city as a resilient city — one that is technologically enabled, connected and agile to address 21st-century environmental, social and economic challenges." - Mike O'Leary. Smart Cities collect data through linked technologies that may be examined to help with decision-making. This action may have the following effects: (i) enhancing the effectiveness of municipal service delivery, (ii) Improving everyone's standard of living and (iii) enhancing equity and prosperity for locals and companies. The main properties of Blockchain that may be used to construct and manage the technology, infrastructure, and operations of a smart city are privacy, interdependence, efficiency, and transparency. Infrastructure implementation is one of the goals that Blockchain concentrates on attaining, and the removal of middlemen is one of its main goals for achieving sustainability. In light of this, the goal of this study is to understand what a Blockchain integration with a city's operations and infrastructure might look like in a future "smart city," while also addressing the complex future of infrastructure sustainability in terms of security and resource management. Blockchain is a system for decentralized data storage and transactions. Interest in blockchain technology has rapidly grown since the concept was first used in 2008. A server database application system called blockchain has an increasing list of data entries that are verified by network nodes or intersection. Depending on the demand, the details of each action are stored in a public or private database. The idea of a hypothetical city becoming a sustainable smart city is presented in this article.

The main grail of the design of a "smart city" is to improve people's quality of life through the maturing of conventional infrastructure while integrating latest technologies like the Big Data, Internet of Things (IoT), Artificial Intelligence (AI),[1] etc. These technologies are being used to fabricate a user-friendly abode that enables interconnection with a variety of digital services and devices. In a smart city, the institutional infrastructure incorporates public and stakeholder viewpoints and ideas when making choices from a sustainability perspective. These opinions are then used to create goals and find solutions by satisfying.

Integration of blockchain in smart cities

Blockchain has a number of built-in capabilities that may be applied to the management of urban infrastructure to reduce or perhaps eliminate issues like pollution, urbanization, and climate change. **Decentralization**(dissemination) is one of them; it is based on the plan that a Blockchain works in a peer-to-peer [2],[3] (P2P) manner without the need for reliable central intermediaries. By doing this, it becomes far less likely that a central body's operation would fail. **Immutability** is another crucial attribute. If a system is difficult to corrupt, it is said to be immutable. Since the security of Blockchain is based on cryptography and includes digital signatures for transactions' certification and hash functions for connecting blocks, the system is challenging to alter and is thus unchangeable. A Blockchain system also exemplifies **Democracy** as an extra connection to the current Blockchain. Each new link or connection is included into the decision-making process, put in place the need for consensus among the existing nodes. **Pseudonymity, Security, and Transparency**[4] are also very important aspects of infrastructure. They improve system security by assigning each Blockchain node a pseudonymous address that masks the node's real identity. Transparency and security are both increased as a result.

II. APPLICATION

The illustration of possible Blockchain applications in sustainable infrastructure was one of the goals of this work. This was done by putting out a potential smart city design that includes Blockchain technology with urban infrastructure such as healthcare, cryptocurrency, supply chain, banking, online services, cellular network, reputation, and power. Blockchain is a novel technology that might have "radical" societal impacts. Fundamentally, it is a "chain" of data made up of discrete chunks that, once added to the sequence, cannot be changed or withdrawn. Every computer in the network maintains an open ledger, which is "a distributed database holding records of transactions that are shared among participating parties" and gives the blockchain its transparency and ability for everyone to independently verify transactions. [5] systems have several benefits over centralized ones, including the fact that they cannot fail if one party decides to cease verifying data, that they remove trust from the network, that they guarantee data dependability, and that they have excellent security.

A. Blockchain use in Cyber Security

- **IoT security**: With the growing use of AI and IoT, data and system security from hackers has always been a top priority. A potential use case for blockchain to maintain cybersecurity in the IoT system involves leveraging device-to-device encryption to secure communication, key management mechanisms, and authentication.[1]
- **Software download integrity**: Blockchain may be used to validate updates and installers to stop malicious software from infecting devices. The integrity of the downloads may be confirmed by comparing new software IDs to the hashes, which are stored on the blockchain in this case.[5]
- **Decentralized storage of crucial data**: Blockchain-based storage solutions assist in achieving decentralised storage, securing digital information, as a result of the daily exponential increase in data generation.[5]
- **Dependability for the Domain Name System**: The Domain Name System (DNS) assists in connecting domain names to their IP addresses, addressing as a sort of general register. Over time, hackers have sought to access the DNS and use these linkages to their advantage, disrupting websites in the process. The DNS may be kept with increased security because to Blockchain's immutability and decentralised systems.[5]

B. Blockchain use in Traffic Management

Any autonomous vehicle that has been registered on the blockchain as an asset will always be in contact with the traffic systems and other vehicles, making it a trackable asset. A navigation system[1] can handle rush-hour traffic issues by directing traffic through other routes so that everyone's average trip time stays the same. Furthermore, the blockchain-powered communication system can instruct vehicles that are about to crash and reroute traffic in a way that prevents or lessens the collision if a vehicle loses control and strikes oncoming traffic.

When used in systems where the same governments and individuals participate in the information-gathering and -sharing process, mobile devices and "connected" cars offer a revolution that can be fully utilised. The approach described in this study attempts to include both drivers and local governments in the utilisation of cutting-edge [6]for improved traffic system management based on floating car data. A

Blockchain would make it feasible to preserve a comprehensive record of all transactions and interactions between drivers and municipal management, allowing for the introduction of incentives to drivers who are ready to contribute trip data.[7]

C. Governance and Blockchain

In the vanguard of third-generation thinking is the idea of using blockchains for governance, which is still in its infancy. The term "governance of the blockchain"[4][5] refers to a blockchain's internal capacity to decide on future software upgrades and modifications to internal protocols by soliciting community input. Voting makes it possible to come to a fair consensus without alienating some community members, which might result in controversial "hard fork" occurrences where a new chain is generated (witnessed to Bitcoin in 2017). Blockchain governance "on-chain" is an illustration of Mode 3[4] governance. The Cardano Project Catalyst (where the community can vote on which projects to finance), the Tendermint protocol from Cosmos, and Tezos are examples of cryptocurrency blockchains with functional "on-chain" governance that self-execute in accordance with the outcome of the vote. The three facets of blockchain governance[5] are decision rights (who has the authority to make decisions), accountability (who is held accountable), and incentives (mechanisms to aid participation).[4]

Decentralized Autonomous Organizations (DAOs)[6], which were created in the second generation of blockchain technology and are evolving in terms of functionality and feasibility in third generation chains, are the main mechanism of governance for blockchains [8]. DAOs are autonomous protocols that are set up to execute smart contracts, keep track of input data, and manage voting according to a set of algorithmic rules that cannot be changed. It has already been argued that DAOs should be used in e-government to automate auditing, submitting bids for contracts, choosing contracts, and producing official documents (like driver licenses). DAOs[4] have recently grown in popularity among cryptocurrency projects and have become easier to use through graphic interfaces (which require no coding skills).[4][7]

D. Blockchain and Health

Finding models that take healthcare from the hospital to the living room is crucial. The Covid-19 has inclined researchers and medical professionals to come up with strategies for easing patient management outside of hospitals and remotely [9]. Health care providers will be able to interact with tools like digital whiteboards and meet face-to-face without the use of elaborate conference technology in the Metaverse. Digital twins[7] will be used to securely test machines, systems, and procedures in order to find flaws and weaknesses before putting them to use in a real-world setting. Creating a digital twin of a hospital course of action, like the in-patient flow, and using advanced analytics to run millions of possible scenarios in order to find the root cause and evaluate various solutions before implementing them[10].

Collaborations are both encouraged and possible in the metaverse. There are areas created by new EdTech companies like Studyum[10] with Metaverse on ramps for organising collaborative activities. Groups of students with comparable levels of achievement can be formed by ranking them based on their activity and performance. Tokens will be used as incentives to promote intra-community cooperation. [1][11]

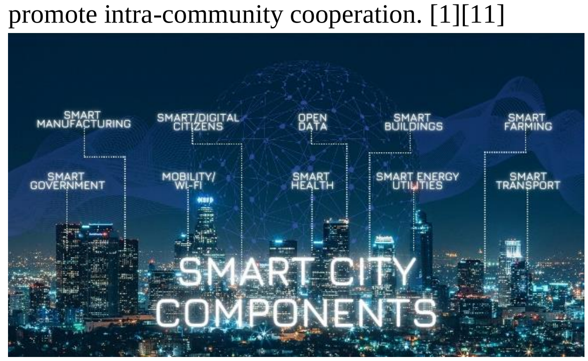

Fig. 1 – Smart City Components (Source – Author)

III. POTENTIAL OF BLOCKCHAIN

Blockchain is a breakthrough technology that could have "root to branch" ramification on society. It functions essentially as a "chain" of data made up of discrete pieces that, once added to the sequence, cannot be changed or withdrawn. Every computer in the network maintains an open ledger, which is what's known as a "distributed database holding records of transactions that are shared among participating parties." This feature of the blockchain makes it visible and subject to widespread verification. The ledger is a shared document that each party has a copy of, making it impossible to change or undo without the protocol's approval. Additionally, it is hard to change or conceal information that is added to the chain, making it a powerful tool for battling corruption and promoting transparency in election voting. A blockchain typically has a cryptographic protocol as its foundation, which is a way to make sure the information in a block is accurate and maintain network security. There are a number of protocols, including "proof-of-work," "proof-of-stake," and "zero-knowledge-proof."[4]

It is already being investigated how blockchain technology might be used in real estate transactions and rents. With governmental services being slashed, rural areas are becoming more and more marginalized, forcing localities to develop their own social innovations to provide these services [4]. Decentralized energy systems, in which localities run their own renewable energy grids, are one way to do this. The Energy Web Foundation[5] is a project that pursues in blockchain solutions for renewable energy networks. However, logistical and trust difficulties around usage vs production frequently afflict decentralised microgrids. If conflicts arise, the blockchain might give a transparent account of everyone's power usage and production. In essence, this is an illustration of how to avoid a "tragedy of the commons" situation. [4]

The tracking of the carbon footprint from energy appliances is one of the uses of blockchain for sustainable power infrastructure. Blockchain features like data security and storage can be used for this purpose. The generation of data is reliable since it is impossible to change the amount of carbon created once it has been recorded. A product's carbon footprint can be studied to determine its environmental impact, and both the manufacturer and the user should have access to this data. Management or governing services might charge a fee based on the carbon footprints of such appliances or set a point at which a "carbon" tax[4][7] would be levied in order to discourage the usage of such appliances. The general public's awareness of how their actions affect the environment would increase as a result. Implementing the tax after analysing the products and raising their prices if a greater footprint is seen could be another way to reduce the overall number of products in use. This may also transform the way that these things are supplied and demanded, paving the way for a sustainable future powered by Blockchain technology.

IV. LIMITATIONS OF BLOCKCHIAN TECHNOLOGY

Blockchain has the potential to be a ground-breaking technology, but up until now, adoption and development have been sluggish. Scaling blockchains is a challenge for developers, and there are currently no effective solutions. This is because a blockchain necessitates node consensus and continuous ledger update. Recent developments in "zero-knowledge roll-ups" or sidechains, however, could prove to be a solution to this problem since they can take some transactions away from the main chain and validate them separately to alleviate congestion. Another problem with development is that some projects have been taken advantage of or hacked, which is partly due to the difficulty of effectively developing a smart contract. One way to deal with this is by using a visual interface with a functional programming language, like Cardano's Marlowe application.[4]

Researchers hypothesized that there are a number of barriers to widespread adoption in the private sector, including governance, high costs, the security model (you cannot retrieve a wallet or reverse a transaction), latency (blockchains are not fast enough to process the number of transactions mass adoption would bring), and lack of privacy (important for businesses wanting to hide financial information) (in the sense that a central organization cannot control the governance of the system). Businesses do not willing to drastically restructure their current structures and systems since switching to a blockchain system would be too expensive.

There is presently a lack of research on governance; as a result, there are still limitations and critiques to be found. Major problems might be described as "first mile, final mile" situations, where difficulties arise from getting past early obstacles and then later on in the refining stage. Most concerns center on getting over the "first mile" because blockchain governance is still in its infancy. Getting individuals in authority to give up their position of authority and adopt a new system of transparent and responsible governance is obviously a problem. The challenge of encoding intricate and implicit judgments into a smart contract is one of the main challenges for blockchain governance. Votes that can be answered with a simple "Yes" or "No"[4] are simple to write, but in reality, decisions are sometimes far more nuanced and complex than this, requiring negotiation. Another drawback is the necessity for independent third-party certification of the reliability and correctness of data entered that is not native to the blockchain, which increases complexity and bureaucracy in the process.

Fig. 2 – Benefits of Blockchain (Source – Author)

V. CONCLUSION

The idea of smart cities having more resilient infrastructure has been considered for a while. To help researchers and governments analyses problems, come up with fresh ideas, and make recommendations for the future of developed cities, there is a need for professional data capture and management technology. The prospects for blockchain technology in smart cities are discussed in this study as well as the architecture of future electricity markets. In this essay, the main publications in the fields of data management, cyber security, smart cities that use blockchain to improve government management systems, water pollution and blockchain tracker, trade in water access rights, and power infrastructure were reviewed. The majority of Blockchain applications were then compiled.

This study investigated the potential of blockchain technology to address problems with decentralized rural governance. Additionally, it has established the potential of blockchain as a discussion starter in academic circles on rural development. The use of blockchain technology for rural development is a massive task that must be acknowledged. It undoubtedly starts out small. Blockchains have qualities that make them particularly tempting for increasing the validity, confidence, and transparency of the decision-making process in rural regions, but there are still significant impediments to their development and use. Although blockchain-based governance is fast being created and put into practice, it is yet some time before this becomes a reality. There is a huge need for further theoretical and empirical research, and researchers from many different fields within the social sciences might play a significant role. Around the topic, more theory development is needed. By fusing digital twin[10] technologies, remote sensing systems, and virtual connectivity tools, reliable and secure smart contracts built on blockchain technology result in the harmonization of corporate processes. According to the conclusions drawn from the aforementioned investigations, smart contracts play a crucial role in transactions made possible by blockchain platforms. Smart contracts are made possible by the distributed nature of blockchain technology, which uses geographic mapping, cloud and edge computing, virtual navigation tools, and other technologies. By utilizing network modelling, decision support tools, and geolocation data, the decentralized nature of blockchain improves self-governance in smart cities and gives citizens more control.

ACKNOWLEDGMENT

I want to thank Ms. Varsha Khetrapal, my distinguished adviser, for all the direction, assistance, and training she gave me during my study. A special thanks goes out to Ms. Ankita Srivastav, whose important suggestions and support had a significant impact on the way I did my study and understood my results.

REFERENES

[1] M. Zia, “B-DRIVE: A blockchain based distributed IoT network for smart urban transportation,” Blockchain Res. Appl., vol. 2, no. 4, p. 100033, 2021, doi: 10.1016/j.bcra.2021.100033.

[2] C. J. L. Balsas, “Qualitative planning philosophy and the governance of urban revitalization, a plea for cultural diversity,” Urban Gov., no. September, 2022, doi: 10.1016/j.ugj.2022.09.003.

[3] N. M. S. Nopiyani and I. M. A. Wirawan, “The impact of tourism on the quality of life of communities in tourist destination areas: A systematic review,” Open Access Maced. J. Med. Sci., vol. 9, no. F, pp. 129–136, 2021, doi: 10.3889/oamjms.2021.5966.

[4] I. Merrell, “Blockchain for decentralised rural development and governance,” Blockchain Res. Appl., p. 100086, Sep. 2022, doi: 10.1016/j.bcra.2022.100086.

[5] A. P. Balcerzak, E. Nica, E. Rogalska, M. Poliak, T. Klieštik, and O.-M. Sabie, “Blockchain Technology and Smart Contracts in Decentralized Governance Systems,” Adm. Sci., vol. 12, no. 3, p. 96, Aug. 2022, doi: 10.3390/admsci12030096.
[6] A. P. Balcerzak, E. Nica, and M. Poliak, “administrative sciences Blockchain Technology and Smart Contracts in Decentralized Governance Systems,” 2022.
[7] M. S. Alnahari and S. T. Ariaratnam, “The Application of Blockchain Technology to Smart City Infrastructure,” Smart Cities, vol. 5, no. 3, pp. 979–993, 2022, doi: 10.3390/smartcities5030049.
[8] Z. Yao, B. Li, G. Li, and C. Zeng, “Resilient governance under asymmetric power structure: The case of Enning Road Regeneration Project in Guangzhou, China,” Cities, vol. 111, no. October 2020, p. 102971, 2021, doi: 10.1016/j.cities.2020.102971.
[9] J. Sainz-Santamaria and A. L. Martinez-Cruz, “Adaptive governance of urban green spaces across Latin America – Insights amid COVID-19,” Urban For. Urban Green., vol. 74, no. February 2021, p. 127629, 2022, doi: 10.1016/j.ufug.2022.127629.
[10] R. Article and J. Thomason, “Journal of Metaverse MetaHealth-How will the Metaverse Change Health Care?” [Online]. Available: https://www.influencive.com/flickplays-3d-social-media-platform-
[11] Z. Allam, A. Sharifi, S. E. Bibri, D. S. Jones, and J. Krogstie, “smart cities The Metaverse as a Virtual Form of Smart Cities : Opportunities and Challenges for Environmental , Economic , and Social Sustainability in Urban Futures,” pp. 771–801, 2022.