GJR Publication
OPEN ACCESS

Global Journal of Research in Engineering & Computer Sciences
ISSN: 2583-2727 (Online)
Volume 05| Issue 01 | Jan.-Feb. | 2025
Journal homepage: https://gjrpublication.com/gjrecs/

Review Article

Challenges with Blockchain Adoption and how to avoid them

[1]Umar Baban Turai, [2]Abdulkadir Shehu Bari, [3]Muhammad Ahmad Baballe*

[1]Nigeria Special Constabulary Police, Kano State Command, Nigeria.
[2]Department of Computer Science, Audu Bako College of Agriculture Danbatta, Kano, Nigeria.
[3]Department of Mechatronics Engineering, Nigerian Defence Academy (NDA), Kaduna, Nigeria.

DOI: 10.5281/zenodo.14737437 **Submission Date: 23 Dec. 2024 | Published Date: 25 Jan. 2025**

Corresponding author: Muhammad Ahmad Baballe
Department of Mechatronics Engineering, Nigerian Defence Academy (NDA), Kaduna, Nigeria.
***ORCID**: 0000-0001-9441-7023*

Abstract

By 2030, the Internet of Things (IoT), which has transformed worldwide interactions through the Fourth Industrial Revolution (4IR), will have connected over 40 billion devices, posing serious privacy, security, and protection issues. Using its fundamental features—immutability, data integrity, transparency, and consensus—blockchain technology provides a decentralized, safe, and transparent solution for data sharing and storage. This allows for real-time tracking, tamper-proof records, and safe data sharing in supply chain management and healthcare. Blockchain-IoT convergence promises revolutionary advantages, such as increased efficiency, lower costs, and higher security, despite the hefty implementation costs. This paper offers a thorough examination of blockchain's possible uses in the Internet of Things, emphasizing how it might improve supply chain management, simplify safe healthcare data transmission, improve data security and privacy, and allow real-time tracking and monitoring. Blockchain-based supply chain management, regulatory frameworks, scalability solutions, interoperability protocols, and quantum-resistant blockchain networks are some of the areas that will be the focus of future study.

Keywords: *Blockchain, Internet of Things (IoT), Fourth Industrial Revolution (4IR), Datafication, Security, Healthcare.*

I. INTRODUCTION

The Internet of Things (IoT) is an evolving and innovative technology that is becoming increasingly important due to its potential impact and role in our everyday lives to build smarter societies in the Fourth Industrial Revolution (4IR). In 1999, Kevin Ashton coined the term "Internet of Things" (IoT) and described the ability of connected sensors to bring new services to the Internet. At that time, 2025 years ago, it was the scope of the Internet of Things (IoT). On the other hand, blockchain (BC) is a decentralized, distributed ledger technology that enables secure, transparent, and tamper-proof data management. Interest in blockchain technology began significantly in 2008 and has been growing continuously. Blockchain technology development has created an impact, especially in terms of tracking, coordinating, executing, and storing information from many devices and providing data transparency, security, and provenance. Secure and traceable transactions can be processed and executed by using blockchain technology without third-party involvement. Furthermore, smart and digital devices have become smarter and smaller in size, which is being implemented in various Internet of Things (IoT), such as smart home appliances, agriculture, infrastructure management, healthcare, defence, intelligence, education, and supply chain management. IoT devices can collect data both confidentially and privately, and there are many security-related threats and weaknesses that aim to realise today's IoT infrastructure. This high generation of data is being regarded as the datafication of societies. In addition, IoT solutions in usage are expensive due to the costs associated with the hardware infrastructure and maintenance. The scalability and widespread usage of the IoT raise serious protection and security issues. Further, existing integration strategies for providing protection, security, and information processing require high-specified servers with centralised network architectures supporting the IoT. In short, the failure of a centralised server increases the risk of the entire network infrastructure. For instance, a denial of service (DOS) successful attack on a centralised server can result in a single point of failure. Therefore, a centralised approach can be risky for the development of applications on the IoT-based platform. These challenges require a fundamental rethinking of the structure of the IoT.

Interestingly, blockchain technology is one of the best options as it is a secure, decentralised ledger maintenance system that can support the Internet of Things. Blockchain innovation has become the mainstream standard and is broadly utilised in different businesses, such as agriculture and finance. From a high-level perspective, the blockchain uses a large amount of encryption to provide "untrusty" functionality. There is no centralised authorisation network so that data transaction nodes can achieve faster coordination. Serverless infrastructure is built using the unique capabilities of the BC. This research argues that the integration of internet of things (IoT) with blockchain (BC) results in an interesting combination of blockchain IoT that will eliminate several issues and improve fault tolerance. Furthermore, it can also prevent the bottleneck inherent in the growing IoT that relies on centralised servers. As blockchain is based on a distributed peer-to-peer network offering a decentralised architecture that enables IoT device autonomy, end-to-end communication can run services without running a central server. In addition, in the blockchain network, the participants can verify the integrity of the data being sent and the sender's identity. There is no single entity to control the blockchain content; the internet of things (IoT) information and logs stored in the blockchain (BC) are permanent, ensuring transparency, security, privacy, and traceability. A reliable internet of things (IoT) is a major contribution to blockchain. The blockchain provides logical functions through smart contracts and can treat internet of things (IoT) interactions as transactions [7-11, 18-20].

II. LITERATURE REVIEW

Blockchain is evolving to become a platform for securing Internet of Things (IoT) ecosystems. Still, challenges remain. The purpose of this literature review is to highlight the applicability of blockchain as a medium to secure IoT ecosystems. A two-dimensional framework anchored on (1) IoT layers and (2) security goals is used to organize the existent IoT security threats and their corresponding countermeasures identified in the reviewed literature. The framework helped in mapping the IoT security threats with the inherent features of blockchain and accentuated their prominence to IoT security [1]. This study also includes a taxonomy that mentions the aspects and areas in the healthcare domain incorporating the traditional system with the integration of IoT and blockchain to provide transparency, security, privacy, and immutability. This study also includes the incorporation of related sensors and platforms of blockchain, the objective focus of selected studies, and future directions by incorporating IoT and blockchain in the healthcare domain. This study will help researchers who want to work with IoT and blockchain technology integration in the healthcare domain [2]. This paper provides the opportunities brought about by the Internet of Things, machine learning, Global Positioning system, and blockchain in various waste management techniques, their application scenarios, real-time tracing and tracking of waste, reliable channelization and compliance with waste treatment, efficient waste resource management, protection of waste management documentation, and fleet management. Based on the conducted review, this paper presents open challenges associated with waste management techniques that act as future research directions. Waste bin placement and its security, internet connectivity with waste management components, transportation of waste, and waste disposal techniques are the main categories of challenges associated with waste management. This paper also provides a comparison of the presented review with other published review papers [3]. The research findings show that the blockchain can guarantee fundamental security requirements such as authentication, privacy-preserving, confidentiality, integrity, and access control. Finally, open issues and challenges related to the combination of blockchain and Internet of Drones (IoD) technologies are discussed [4]. In this chapter, we explore the potential role of blockchain technology in addressing the challenges of IoT security and privacy. We begin by examining the fundamental characteristics of blockchain technology and how it can be applied in IoT systems. We then delve into several use cases showing how blockchain technology can enhance the security and privacy of IoT systems, such as SCM, healthcare, and energy management. Finally, we discuss the challenges and limitations of using blockchain technology in IoT, as well as potential future directions for research and development in this area. Overall, this chapter provides insights into the potential benefits of using blockchain technology in IoT and highlights the importance of considering security and privacy in the design of IoT systems [5]. Blockchain (BC) IoT-based applications ensure security, confidentiality, access control, scalability, privacy processes, and authentication to improve processes and performance. This article studies such similarities and analyses to solve blockchain BC-based IoT-related problems, technical limitations, challenges, and privacy issues blockchain (BC) can bring to the internet of things (IoT). This article also presents the use of the blockchain (BC) method in IoT, blockchain (BC) IoT-based application domains, its research challenges, and future directions [6]. The main objective of this work is to conduct a systematic review of the literature on internet of things (IoT) technology and the application of blockchain technology. For this, exhaustive research was carried out, and when analysing the documentation of aspects such as the area of study on the integration of technologies, most used consensus techniques and the benefits of technology were considered. The results of the study indicated blockchain technology with IoT being implemented in companies and industries, with the most consensus techniques being POW and POS, while the benefits are manifested in terms of improved scalability and security of companies [12]. This study utilized the PRISMA review protocol. Two main databases, Scopus and IEEE, were used. Findings show that 20 research papers on security and privacy in blockchain were published between 2020 and 2023 and involved 13 different journals. There are 13 various application areas that are relevant to the security and privacy aspects of blockchain, where the Internet of Things claims the largest portion of representation. The thematic analysis identified seven main themes related to challenges in blockchain security and privacy. The findings also highlight that security and privacy are among the future works that

should be focused on in blockchain technology. In conclusion, the article suggests that the integration of blockchain with IoT can improve security and proposes the development of a framework that enforces privacy on the blockchain [13]. This study shows that security, transparency, and efficiency are the top three motivations for adopting these platforms. The energy, agriculture, health, construction, manufacturing, and supply chain domains are the top domains. The most adopted technologies are cloud computing, fog computing, telecommunications, and edge computing. While there are several benefits to using hybrid blockchains, there are also several challenges reported in this study [14]. The article presents an analytical overview of the issues of integrating blockchain technology into the Internet of Things [17]. The results of the analytical review make it possible to substantiate the purpose and advantages of integrating blockchain technology into the Internet of Things, as well as to summarize the main issues and substantiate a number of tasks for relevant and progressive scientific research in the field of modern information systems. [15].

III. CHALLENGES WITH BLOCKCHAIN ADOPTION AND HOW TO AVOID THEM

1. Lack of adoption

Blockchains are ecosystems that require broad adoption to work effectively. For example, track-and-trace capabilities in supply chains not only require an organization to adopt a blockchain network but for its suppliers to do so as well. APQC found that only 29% of organizations were piloting blockchain or had fully deployed it.

At the time, there was hope that adoption of blockchain would grow. Organizations were coming together and forming collaborative blockchain working groups to address common pain points and develop solutions that could benefit everyone without revealing proprietary information.

Research from Gartner, however, indicated that these challenges persist in 2023. In the research firm's 2023 "CIO and Technology Executive Survey," 8% of respondents said they have deployed blockchain, a figure that is expected to increase to 46% by 2025. Despite the expected growth, numerous business, technical and organizational barriers remain.

The business issues mainly relate to customer education and hesitation. Blockchain vendors face their own issues, including partner hesitation, lack of network effect, limited skills and financial issues. Among the technical challenges are performance and limited interoperability with the necessary systems.

Gartner offered some solutions, however, and said prioritizing education and marketing initiatives are essential steps for product leaders. Showing practical uses of blockchain is also critical to winning over skeptics.

2. Skills gap

Blockchain is still very much an emerging technology, and the skills needed to develop and use it are in short supply. As the figure shows, 49% of respondents to the 2020 survey named the skills gap as a top challenge. The marketplace for blockchain skills is highly competitive and has been for some time. The expense and difficulty of talent acquisition in this area only adds to the concerns that organizations have about adopting blockchain and integrating it with legacy systems.

Gartner's 2023 data indicated that limited tech experience remains a challenge. Vendors often cite this as an issue in product development. This leads to problems creating user-friendly interfaces and adding blockchain applications to existing systems.

However, one way to counteract the skills gap is to use blockchain as a service (BaaS). Such services enable organizations to reap the benefits of blockchain without having to invest significantly in the technical talent behind it. IBM, Amazon Web Services and Oracle are just a few of the many BaaS providers.

This model has already narrowed the skills gap in the context of other technologies, such as robotic process automation (RPA). Rather than having to develop bots and write code in-house, organizations can now look to numerous vendors who have the expertise to implement RPA and customize it for each organization's needs. Users only need to know the basics of the technology and don't need to be programmers to take advantage of its benefits. Similarly, users will need to understand how to execute smart contracts, which use blockchain to automatically execute certain actions once the terms of the contract are met, but they won't need specialized knowledge about the intricacies of distributed ledgers. BaaS has the potential to mitigate the blockchain skills barrier.

3. Trust among users

Lack of trust among blockchain users is the third major obstacle to widespread implementation. This challenge cuts in two directions: Organizations might not trust the security of the technology itself, and they might not trust other parties on a blockchain network.

In theory, every transaction in a blockchain is considered to be secure, private and verified. This is true even though there is no central authority present to validate and verify the transactions, as the network is decentralized. A core part of any blockchain network is the consensus algorithms that drive common agreement about the present state of the distributed ledger for the entire network. It is meant to ensure that every new block added is the one and only version of the truth agreed upon by all the nodes in the blockchain. If it's a public -- as opposed to private -- blockchain, anyone can participate. Despite all of the mechanisms meant to guarantee trust on public blockchains, business leaders have placed greater trust in private blockchains where there are no unknown users.

Gartner research has shown that a lack of standards is also an issue. The novelty of this technology is a large reason for this problem.

4. Financial resources

The fourth barrier to widespread adoption of blockchain, according to APQC's research, is the lack of financial resources. Implementing blockchain is not free, and for many organizations the pandemic and disruption of 2020 left budgets tight. However, one other lesson learned from the pandemic is that organizations, and IT departments in particular, can change faster than previously thought possible.

A closer examination of this barrier shows that it is connected to an underlying lack of organizational awareness and understanding of blockchain. APQC has found that as awareness of new technologies becomes more widespread, the ability to effectively make a business case for their adoption improves accordingly. This will be true of blockchain as well, provided that blockchain advocates focus on building a business case that demonstrates how the benefits of the technology will offset the resources needed for implementation.

Vendors also face financial challenges in financing blockchain applications and the runtime infrastructure needed to support them, along with the inherent complexities.

5. Blockchain interoperability

As more organizations begin adopting blockchain, many tend to develop their own systems with varying characteristics -- governance rules, blockchain technology versions, consensus models, etc. These separate blockchains do not work together, and there is no universal standard to enable different networks to communicate with each other.

Blockchain interoperability includes the ability to share, see and access information across different blockchain networks without the need for an intermediary or central authority. The lack of interoperability can make mass adoption an almost impossible task.

With the impacts of the pandemic, in a business environment where collaboration across functions and with suppliers and customers is more important than ever, blockchain interoperability will be critical. It is the only way organizations will truly get the most value out of their blockchain investments. Since 2019, researchers reported seeing an increasing number of interoperability projects meant to bridge the gap between different blockchains. Many of them are aimed at connecting private networks to each other or to public blockchains. These systems will ultimately be more useful to business leaders than prior approaches that focused on public blockchains and cryptocurrency-related tools.

However, as of 2023, interoperability remains a major roadblock to the widespread application of blockchain-based tools. In fact, Gartner named interoperability as a top technical challenge, particularly with legacy systems.

Gartner noted encouraging steps to enhance interoperability across networks, including development of cross-chain communication protocols and standardized data formats.

Along with the five issues that emerged from the APQC survey, the Gartner report noted two other common challenges associated with blockchain technology.

6. Slow development pace

Blockchain technology is complicated. New products often require extensive research, development and validation. For this reason, products can be slow to come to market.

Complementary and postproduction vendors, however, do not face these issues as often. Gartner researchers surmised this is because the tools they use are more advanced.

7. Lack of regulation

According to Gartner, some blockchain vendors have indicated issues because of limited regulations during certain parts of the process. Regardless, lack of clarity about the regulatory requirements creates significant risk for blockchain providers and consumers.

Looking forward

It would be naive to claim that these blockchain challenges aren't significant barriers to its adoption. Broadly speaking, though, many of blockchain's biggest challenges are just the growing pains that are common with any new technology. In making the business case for adoption, blockchain advocates will need to convince their organizations to take the kinds of risks, form the kinds of relationships and make the kinds of tradeoffs that are common in other areas of business.

Leaders can also take steps to ensure that their products are developed in the most efficient way possible. These include publishing case studies to highlight the advantages of blockchain and forming strategic partnerships to navigate the blockchain ecosystem.

Given the benefits that organizations are already deriving from blockchain and the increasing calls for visibility and transparency between organizations, blockchain could someday be a powerful solution to some longstanding problems [21].

IV. BENEFITS OF BLOCKCHAIN TECHNOLOGY

1. Immutability

   Since blockchain technology promotes immutability, recorded data cannot be removed or replaced. As a result, the blockchain stops data manipulation inside the network. Immutability is not a feature of traditional data. To guarantee correct application operation, the traditional database employs CRUD (create, read, update, and delete) at the primary level. The CRUD paradigm makes data erasure and replacement simple. Such information may be vulnerable to hacking by outside parties or rogue administrators.

2. Transparency.

Any network user can validate data entered into the blockchain because it is decentralized. The public can therefore have faith in the network. A typical database, on the other hand, lacks transparency and is centralized. A limited set of data is made available by the administration, and users are unable to confirm information at any time. However, they are still unable to confirm the information.

3. Censorship
   Since blockchain technology is not governed by a single entity, it is unaffected by censorship. As a result, the network cannot be stopped by any one entity, even governments. In contrast, traditional databases have centralized authorities that control network operations and have the power to restrict content. Banks, for example, have the authority to suspend users' accounts.
4. Traceability
   Blockchain makes it simple to trace network changes by creating an irreversible audit trail.
   There is no guarantee of a persistent trail because the typical database is neither visible nor unchangeable [16].

V. DRAWBACKS OF BLOCKCHAIN TECHNOLOGY

1. Speed and performance
   Because blockchain technology performs more operations than traditional databases, blockchain is significantly slower. It first verifies signatures, which entails cryptographically signing transactions. Additionally, blockchain uses a consensus process to verify transactions. Proof of work is one of the consensus methods with a poor transaction throughput. Lastly, there is redundancy, in which every node in the network must be essential to confirming and storing every transaction.
2. High implementation cost
   Blockchain is more expensive than a conventional database. Incorporating blockchain into a business's operations also requires careful strategy and implementation.
3. Data modification.
   Blockchain technology does not allow easy modification of data once recorded, and it requires rewriting the codes in all of the blocks, which is time-consuming and expensive. The downside of this feature is that it is hard to correct a mistake or make any necessary adjustments.
4. Not every need can be satisfied by a single solution, and blockchain technology is no exception. The industry is abuzz with talk about Web3 and blockchain, and many companies are trying to make the transition from Web 2.0 to Web3, but this is not a simple "lift-and-shift" kind of solution. Businesses should plan their development or Web3 migration appropriately after doing a thorough study and due diligence to see whether blockchain technology meets their demands [16].

VI. CONCLUSION

The integration of blockchain technology and the Internet of Things (IoT) has transformative potential [22]. Our review of existing literature highlights the benefits, drawbacks, and challenges of this convergence, and indeed, the future directions required.

The key Findings:

1) Enhanced security: Blockchain's decentralised architecture and cryptographic algorithms secure IoT data.
2) Improved transparency: Blockchain's immutable ledger enables real-time tracking and monitoring.
3) Efficient data management: Blockchain-based IoT networks optimise data storage and processing.
4) Scalability limitations: Current blockchain infrastructure struggles to support large-scale IoT deployments.

Future Research Directions.

This paper argues on the need to prioritise some innovative activities as the research direction in the future. These are:

1) Scalability Solutions: Investigate novel consensus algorithms, sharing, and off-chain transactions.
2) Interoperability Protocols: Develop standards for seamless communication between blockchain and IoT devices.
3) Regulatory Frameworks: Establish guidelines for data privacy, security, and intellectual property.
4) Blockchain-based Supply Chain Management: Explore applications in inventory tracking, authentication, and logistics.
5) Quantum-Resistant Blockchain Networks: Develop cryptographic techniques resilient to quantum computing threats.

Recommendations: The following are also recommended:

1) Implement hybrid blockchain architectures combining public and private networks.
2) Leverage edge computing for real-time data processing and analysis.
3) Develop IoT-specific blockchain platforms with optimised resource utilisation.
4) Foster collaboration between industry stakeholders, academia, and regulatory bodies.
5) Conduct thorough risk assessments and security audits.

By addressing these research directions and recommendations, we can unlock the full potential of Blockchain-IoT enabled systems, driving innovation and growth across industries [23].

V. REFERENCES

1. El-Masri, M., Hussain, E.M.A., "Blockchain as a mean to secure Internet of Things ecosystems – a systematic literature review", Journal of Enterprise Information Management, Vol. 34, No. 5, pp. 1371-1405, 2021, https://doi.org/10.1108/JEIM-12-2020-0533.
2. Zainab, U. K., at al., "Integration of Internet of Things and blockchain technology in healthcare domain: A systematic literature review", International Journal of Communication Systems, Volume 36, Issue 16, 2023, https://onlinelibrary.wiley.com/doi/epdf/10.1002/dac.5582.
3. Singh, S., Chhabra, R. & Arora, J., "A Systematic Review of Waste Management Solutions Using Machine Learning, Internet of Things and Blockchain Technologies: State-of-Art, Methodologies, and Challenges", Arch Computat Methods Eng 31, Pp. 1255–1276, 2024, https://doi.org/10.1007/s11831-023-10008-z.
4. Harbi, Y., Medani, K., Gherbi, C. et al., "A Systematic Literature Review of Blockchain Technology for Internet of Drones Security", Arab J Sci Eng 48, Pp. 1053–1074, 2023, https://doi.org/10.1007/s13369-022-07380-6.
5. Pramod R. G., Satish R. J., Jaime L., Karishma A., "The Role of Blockchain Technology in the Internet of Things", Internet of Things, ISBN: 9781003282945, Pp. 54, 2024.
6. Junaid, N., Q., et al., "Blockchain applications for the Internet of Things: Systematic review and challenges", Microprocessors and Microsystems, Science Direct, 94, 2022, https://www.elsevier.com/locate/micpro.
7. Kevin. Ashton, That 'Internet of Things' thing, RFID Journal Vol. 22, No. 7, Pp. 97–114, 2009.
8. Fadele A. A., Mazliza O., Ibrahim A. T. H., Faiz A., "Internet of Things security: A survey.", Journal of Network and Computer Applications Vol. 88, Pp. 10–28, 2017, https://doi.org/10.1016/j. jnca.2017.04.002.
9. Borgohain, Tuhin, Uday K., Sugata S., "Survey of security and privacy issues of internet of things." arXiv preprint arXiv:1501.02211, 2015, htt ps://doi.org/10.48550/arXiv.1501.02211.
10. Pureswaran V, Sanjay P., Sumabala N., Paul B., "Empowering the edge-practical insights on a decentralized internet of things.", IBM Institute for Business, Vol. 17, 2015.
11. Nick. Szabo, Formalizing and securing relationships on public networks, First Monday Vol. 2, No. 9, 1997, https://doi.org/10.5210/fm.v2i9.548.
12. Alfredo, D. V., et al., "Blockchain Technology Aimed at Solving Internet of Things Challenges: A Systematic Literature Review", Volume 12, Issue 2, pages 757-768, TEM Journal, DOI: 10.18421/TEM122-20, May 2023.
13. Noraini M. B., Quah W. B., "Blockchain for Security and Privacy: A Systematic Literature Review", Applied Information Technology and Computer Science, Vol. 5, No. 1, Pp. 1360-1382, 2024.
14. Alkhateeb, A., Catal, C., Kar, G., Mishra, A., "Hybrid Blockchain Platforms for the Internet of Things (IoT): A Systematic Literature Review", Sensors, Vol. 22, Pp. 1304, 2022, https://doi.org/10.3390/ s22041304.
15. Roman, S., et al., "Integration of Blockchain Technology into the Internet of Things (Overview)", UDC 004.75, 004.77 https://doi.org/10.20535/2786-8729.4.2024.311745.
16. https://www.forbes.com/councils/forbestechcouncil/2022/10/20/advantages-and-disadvantages-of-blockchain-technology/.
17. Isa A. I., Muhammad A. B. "An overview of the Internet of Things (IoT) Architecture", In Global Journal of Research in Engineering & Computer Sciences, Vol. 4, Number 5, pp. 34–39, 2024. https://doi.org/10.5281/zenodo.13750012.
18. Falilat O. J., Usman G. A., Isa A. I., "An Overview of Blockchain Technology Adoption", Journal of Computer Science and Information Technology, Vol. 7, No. 2, pp. 26-36, 2019.
19. Isa A. I., "Blockchain in Nigeria", December 2019, https://www.researchgate.net/publication/329211999_Blockchain_in_Nigeria?enrichId=rgreq-fe221f50ef210c395d0c3e79e55271cd-XXX&enrichSource=Y292ZXJQYWdlOzMyOTIxMTk5OTtBUzo5Mzk5MDYwMzM1MjA2NDBAMTYwMTEwMjQ2OTI5MA%3D%3D&el=1_x_2&_esc=publicationCoverPdf.
20. Isa, A. I., "Nigeria's Ethical Issues in the Use of ICT", 2018, https://www.researchgate.net/publication/325253081.
21. https://www.techtarget.com/searchcio/tip/5-challenges-with-blockchain-adoption-and-how-to-avoid-them.
22. Isa, A., I., Muhammad, A., B., "Theoretical perspectives on digital globalization: A critical review", Edelweiss Applied Science and Technology, Vol. 8, No. 6, Pp. 4384-4388, 2024, DOI: 10.55214/25768484.v8i6.2938.
23. Isa, A., I., Muhammad, A., B., "Enabling blockchain-IoT convergence for industrial revolution 4.0 innovation: A critical review", Edelweiss Applied Science and Technology, Vol. 8, No. 6, pp. 3668-3673, 2024, Publisher: Learning Gate DOI: 10.55214/25768484.v8i6.2804.

CITATION

Umar B. T., Abdulkadir S. B., & Muhammad A. B. (2025). Challenges with Blockchain Adoption and how to avoid them. In Global Journal of Research in Engineering & Computer Sciences (Vol. 5, Number 1, pp. 33–37). https://doi.org/10.5281/zenodo.14737437