

Artificial Intelligence Techniques and Block chain Integration in Healthcare, Electrical Systems, Data Science, and Computer Vision

Alexandra Harry^{1*}

¹Independent Researcher Washington DC USA

Alaxendraharry37@gmail.com



Corresponding Author

Alexandra Harry¹
Alaxendraharry37@gmail.com

Article History:

Submitted: 31-03-2026

Accepted: 05-05-2026

Published: 10-05-2026

Keywords:

Artificial Intelligence, Block chain, Healthcare, Electrical Systems, Data Science, Computer Vision, Smart Systems, Data Security.

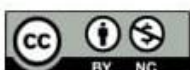
American Journal of Artificial Intelligence and computing is licensed under a Creative Commons Attribution-Noncommercial 4.0 International (CC BY-NC 4.0).

ABSTRACT

The convergence of Artificial Intelligence (AI) and block chain is becoming a game-changer in various fields, such as healthcare, electrical systems, data science, and computer vision. AI allows for intelligent data analysis, prediction and automation while block chain provides decentralized, secure and tamper-proof data management. The two converge to make the systems more transparent, trustworthy, and efficient and overcome the challenges like data privacy, scalability, security threats and more. It is used in healthcare to enhance the diagnosis and management of records, in electrical systems for the optimal distribution of energy, in data science to process it securely and in computer vision for the proper processing of visual data. Although there are difficulties, there are great opportunities for integration of future intelligent systems.

INTRODUCTION

The current-day development of computational intelligence and distributed ledger technologies has made an incredible change in the landscape of modern digital systems. Where once AI and block chain operated as distinct fields of study, they are now beginning to converge in an attempt to solve problems that involve complex, data-rich and security-critical issues in several disciplines [1]. The



introduction section of this review is meant to prepare the reader to grasp the motivation behind this merging of disciplines to become one of the main research prospects in recent years, especially in healthcare, electrical systems, data science, and computer vision [2].

AI, in short, is the ability of machines to perform tasks that involve thinking, logic, decision making, and pattern recognition. The ability of AI systems to analyze vast amounts of data, find hidden patterns, and make accurate predictions with minimal involvement from humans is made possible by the recent developments in machine learning, deep learning, and neural networks [3]. While AI has advantages, it also has some drawbacks, such as privacy concerns, transparency issues, the risk of adversarial attacks, and reliance on centralized data storage systems.

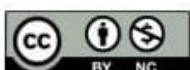
However, block chain technology is decentralized and distributed ledger system that guarantees secure, transparent, and tamper-proof data management. Reduces the need for intermediaries and offers immutability, traceability, and trust to digital transactions. While block chain was first conceived for crypto currencies like Bitcoin, it has also been put to use in other areas like healthcare record management, energy trading systems, supply chain tracking, and secure data sharing [4].

The drive behind AI and block chain integration is to capitalize on their complementary capabilities. AI is great for intelligent data analysis and forecasting, whereas block chain brings about data integrity, security, and decentralization. They form together systems that are not only smart but also reliable and robust [5]. In healthcare, AI can be used to analyze patient data for diagnosis, and block chain can be employed to ensure that patient records are secure and cannot be easily tampered with. Just as in electrical systems, AI can be used to improve the efficiency of energy use, and block chain technology can be applied to enable safe and secure peer-to-peer energy trading in smart grids [6].

This review's main goal is to offer a comprehensive and structured overview of cutting-edge AI techniques and block chain integration in four key areas: computer vision, data science, electrical systems, and healthcare. It also seeks to identify current problems, research gaps and future prospects in this Trans disciplinary area. This section sets the framework of the study by highlighting the relevance of the study in real scenarios, recent developments, and future trends where the convergence of AI and block chain technology has created a practical impact. This provides the foundation for a more detailed discussion of technical topics, domain-specific applications, and comparisons in the rest of the review.

FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence or AI is a multi-disciplinary field of computer science that deals with the process of designing a system to accomplish tasks which normally require human intelligence. These activities involve learning from experience, reasoning, problem-solving, perception, language



understanding and decision-making [7]. In the last few decades, however, AI has progressed from being rule-based tools to the more sophisticated machine learning models and deep learning algorithms that are capable of working with vast quantities of data and making very accurate predictions. The development of AI has transformed it into a cornerstone technology for various modern intelligent systems such as healthcare diagnostics, financial forecasting, autonomous systems, and computer vision applications [8].

Machine Learning (ML) is at the heart of AI, a field of study within AI that allows systems to learn patterns from data without explicit programming. In general, there are three types of machine learning: supervised learning, unsupervised learning, and reinforcement learning. Supervised learning has been very widely used in classification and regression problems, like predicting whether a patient has a disease or whether a photo is a dog or a car, and is trained on labelled data [9]. Unsupervised learning, however, involves unmarked data and aims to identify patterns or structures that exist in the data, such as clustering and anomaly detection. Reinforcement learning is a type of learning where the agent interacts with an environment and gets rewarded or punished as a result of such interaction, and is broadly used in game playing, robotics and autonomous systems [10].

Another major advancement in AI is Deep Learning (DL), which is inspired by the structure and functioning of the human brain. Deep learning is the use of multiple-layered artificial neural networks to learn high-level features from raw data. The artificial neural networks (ANNs) are the elementary structure and more specialized architectures like convolutional neural networks (CNNs) are extremely effective for processing tasks in images and videos [11]. CNNs automatically learn spatial properties, which are crucial in computer vision tasks such as object detection, facial recognition, and medical imaging analysis. Recurrent Neural Networks (RNNs) are well-suited for sequential data, like time series, or natural language, thus being helpful in speech recognition and language translation [12]. The advent of recent years, Transformer models and generative AI systems have transformed the landscape of natural language processing and content creation by facilitating the processing of vast amounts of context.

Beyond enhancements, there is ongoing work in the field of AI research on Explainable AI (XAI) and ethical issues. In high-stakes sectors like healthcare and finance, transparency is vital for building trust and accountability, especially as AI systems become more integral to decision-making [13]. Transparent systems are crucial in these important areas to foster trust and accountability, particularly in sectors like healthcare and finance where AI systems are becoming more central to decision-making. Explainable AI seeks to make model decisions comprehensible to humans, while ethical AI tackles matters like bias, fairness, privacy, and responsible utilization [14].

The principles of AI are instrumental in developing intelligent systems that learn, adapt, and evolve over time. These concepts are crucial for grasping more complex applications, particularly in the context of emerging technologies such as block chain, when combined with AI. It improves the intelligence level of systems and security, transparency, reliability, etc. in different areas as a result of integration [15].

INTEGRATION OF ARTIFICIAL INTELLIGENCE AND BLOCK CHAIN

The integration of Artificial Intelligence (AI) and block chain is a significant combination that not only complements their respective strengths but also servers as a solution to their weaknesses, leading to an overall better system performance, trust and intelligence. While AI is mainly about data-driven learning, prediction, and decision making automation, block chain has been developed to offer a decentralized, secure, and immutable data storage and sharing system [16]. Together, all these technologies give rise to intelligent systems which are data-driven, transparent, secure and resistant to manipulation.

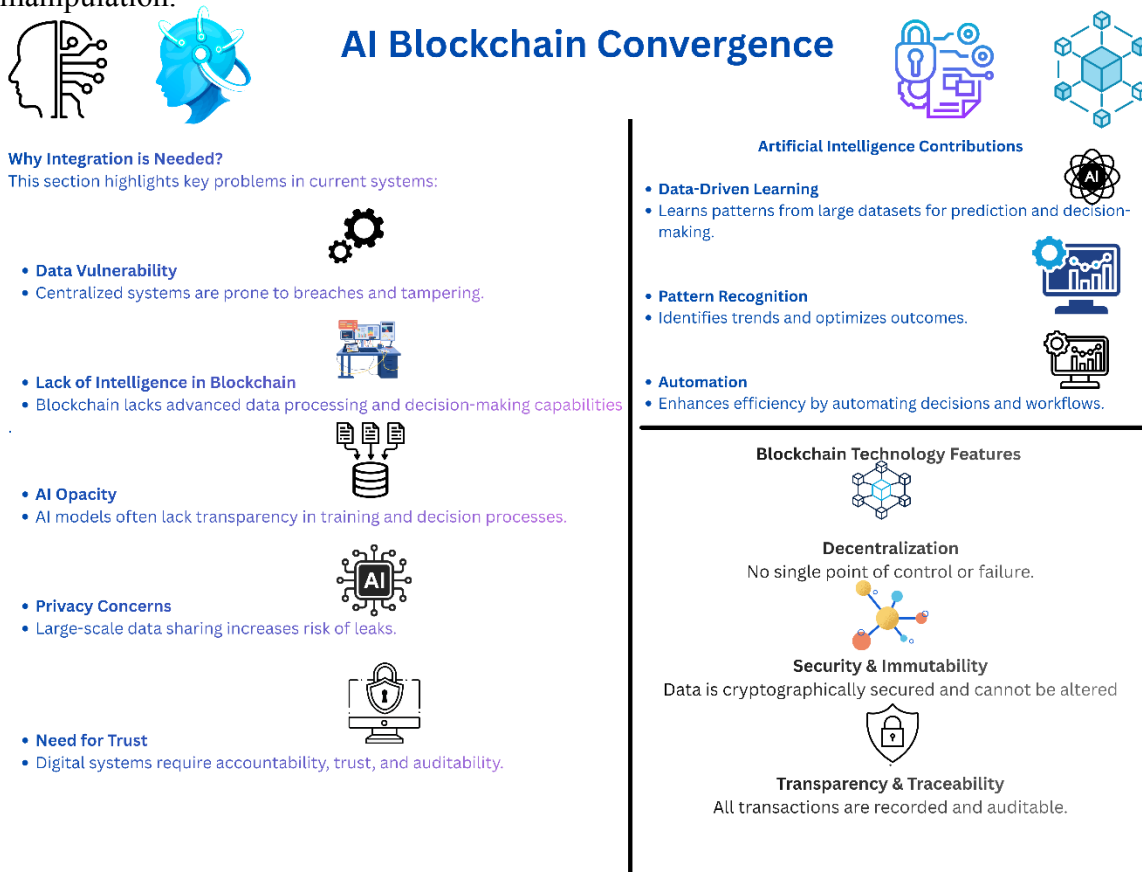


Figure 1. AI Block chain Convergence

Several key issues in today's digital landscape drive the need for AI–block chain integration. AI systems generally need extensive amounts of good quality data to learn and make decisions. But these kinds of data are frequently kept in centralized repositories which are susceptible to breach,

unauthorized entry, and manipulation [17]. Block chain solves this problem by storing data in a way that doesn't rely on any single entity. Block chain's decentralized data storage system gives information integrity and traceability by distributing it among various nodes. Concurrently, block chain itself is unable to provide intelligent data processing, and AI does just that. This complementary relationship is the starting point for their integration [18].

AI-Integrated block chain systems involve integrating AI techniques into block chain networks to optimize consensus mechanisms, enhance decision-making processes, and improve scalability. For example, AI algorithms can be used to predict transaction loads, detect anomalies in block chain activity, and optimize mining or validation processes. This results in better efficient and intelligent functions of block chain [19]. Block chain for secure AI models centers around leveraging block chain to enhance the transparency, security, and accountability of AI models. Trust is one of the big issues with AI – lack of transparency in the training of models and decisions made [20]. Block chain can provide a complete record of all information, from data collection, modelling training, to outputs, making it auditable and tamper-proof. This is especially the case in areas like healthcare and finance, where transparency of decisions is crucial [21].

Another key element of this integration is decentralized intelligence structures. This approach involves deploying AI models on several nodes within a block chain network, allowing them to learn together without relying on a central source of data. It's similar to federated learning, in which data stays on local devices and only model updates are securely transferred via a block chain network. This not only increases the privacy but also minimizes the chances of data becoming leaked [22]. The combination of AI and block chain brings a number of benefits such as data security, trust, prevent fraud, automation, and resilience. It also poses certain challenges including high computational complexity, high latency, scalability concerns, and energy consumption concerns. Also, having to connect two very complicated systems demands high level infrastructure and system design [23].

AI AND BLOCK CHAIN IN HEALTHCARE

AI and block chain are among the most impactful digital advancements to revolutionize healthcare. Two of the most impactful digital advancements that are transforming the healthcare industry are AI and block chain. AI contributes to healthcare systems with advanced data analytics, prediction capabilities, and automation, while block chain ensures the secure, transparent, and tamper-proof management of sensitive medical data [24]. They are increasingly becoming perceived as a solution to some chronic issues like; data fragmentation, privacy concerns, poor record management, and lack of interoperability between healthcare systems.

Artificial Intelligence has a wide range of applications in healthcare. Another key application is in the

field of disease diagnosis and prediction, where machine learning algorithms are used to predict the onset of diseases as early as possible. This includes forecasting diabetes, cancer, cardiovascular diseases, etc., according to clinical history, genetics, and lifestyle. Medical imaging analysis is another significant application, where deep learning models like convolutional neural networks (CNN) can be used to accurately identify abnormalities in X-rays, CT scans, and MRI images [25]. AI is also widely used in drug discovery and personalized medicine, where it helps identify potential drug candidates and tailor treatments based on individual patient characteristics. Furthermore, AI can aid remote patient monitoring systems, which analyze health data gathered from wearable devices and sensors in real time [26].

While Block chain technology offers a range of benefits to complement AI, it also addresses key challenges in healthcare systems, such as security and trust. Its most notable use is in Electronic Health Records (EHRs), in which patient information is securely stored in a decentralized way. This means that medical records are impossible to alter, and everyone needing access to them can easily identify them and access them only with permission [27]. Additionally, block chain allows for the secure sharing of patient data among healthcare providers, such as hospitals, laboratories, and insurance companies, while ensuring the privacy of patient information. In health care supply chain management, block chain is being leveraged for traceability of pharmaceuticals throughout the supply chain, including from manufacturers to patients, to avoid counterfeit drugs and ensure product authenticity [28]. Additionally, block chain bolsters patient privacy and consent control by enabling patients to regulate who can access their well being data with cryptographic permissions and smart contracts.

AI and block chain in healthcare form a formidable duo, with the technology of AI complementing the security of block chain. When combined with the power of AI, block chain can be used to process vast amounts of health-related data and draw conclusions, and the block chain guarantees that the information is reliable and cannot be tampered with [29]. AI models can be trained on block chain-ensured data sets, for instance, with a greater diagnostic precision without the risk of data manipulation or unauthorized access. This arrangement also makes it easier to do collaborative healthcare research because it allows patient data to be securely shared across institutions without compromising patient anonymity [30].

The technology has promise, it also presents some obstacles such as the cost of computation, scalability, compatibility with various healthcare systems, and regulatory concerns related to data privacy laws. Also, the integration of both technologies is complex and involves experts and highly advanced infrastructure [31]. The potential of AI and block chain in healthcare is immense, and the

future looks promising. As federated learning, edge computing, and decentralized health networks continue to evolve, their impact on healthcare systems is poised to be intelligent, secure, and patient-centric, ultimately enhancing the accuracy of diagnosis, effectiveness of treatment, and quality of healthcare provision [32].

AI AND BLOCK CHAIN IN ELECTRICAL SYSTEMS

The application of Artificial Intelligence (AI) and block chain technology in electrical systems is a key focus in the realm of next-generation smart grids and intelligent energy management solutions. However, the demand for electricity is growing, the integration of renewable energy sources, and the desire to efficiently and reliably distribute electricity, are making modern electrical networks more complex. AI brings an added layer of sophisticated analytics and decision making power, while block chain technologies deliver secure, transparent and decentralized energy transactions [33].

In the electric sector, block chain provides a secure, transparent, and decentralized way of managing data and conducting energy transactions. One of the more promising applications is peer-to-peer (P2P) energy trading, in which a consumer who produces surplus energy using a renewable energy source can sell electricity to another consumer without going through a middleman [34]. The block chain provides a secure, transparent and automatic execution of these transactions via smart contracts. Another field of application is decentralized energy management, where the block chain can be used to manage energy resources in a decentralized way, which decreases the reliance on central authorities. This enhances the resilience and flexibility of the energy networks. In addition, block chain can be leveraged for secure smart metering systems, where the data from smart meters is then recorded in an immutable way, so as not to allow any tampering with the data and thus guarantee accurate billing [35].

Smart grids powered by AI and block chain technology. Smart grids powered by AI and block chain technology. With real-time energy data being analyzed by AI, energy generation, distribution, and consumption are optimized, and block chain technology makes sure that all energy transactions and data exchanges are secure and transparent. For example, AI can forecast high energy use times, and block chain can support automatic energy swaps during those high energy consumption time, balancing loads and minimizing energy loss [36].

However, there are some drawbacks. These include scalability issues in block chain networks, high computational requirements for AI algorithms, interoperability between legacy power systems and modern digital technologies, and regulatory challenges in implementing decentralized energy markets. Also, certain block chain consensus mechanisms require a lot of energy and this may be an issue in a sustainable electrical system [37]. The synergy between AI and block chain in electrical

systems is poised to create more intelligent, efficient, and decentralized energy networks of the future. Overall, it can help to increase the reliability of the power grid, reduce reliance on fossil fuels, and allow consumers to become more engaged with the energy market, paving the way for the creation of more sustainable and intelligent power systems in the future [38].

AI AND BLOCK CHAIN IN DATA SCIENCE

Artificial Intelligence (AI) and block chain technology are transforming data science in the era of intelligent systems by revolutionizing data collection, storage, analysis, and sharing. Data science heavily depends on the analysis of vast amounts of data, statistical modeling, and machine learning methods to derive valuable insights from both structured and unstructured data. Yet, classic data systems are plagued with significant issues like data privacy dangers, lack of transparency, data tampering, and control [39]. This AI-driven, block chain-supported approach combines the strengths of AI with block chain, providing a compelling solution to these challenges.

Artificial Intelligence is a key component in data science, facilitating complex analysis and forecasting. The data is huge and is processed using AI techniques like machine learning and deep learning to discern patterns that are difficult to see with traditional approaches. AI plays a crucial role in big data analytics, which involves processing vast amounts of data from various sources like social media, sensors, health records, and financial transactions in real time [40]. These practices enable organizations to leverage data for informed decision-making, boost operational efficiency, and enhance predictive capabilities. Moreover, AI is playing a widespread role in data classification, clustering, anomaly detection, and regression analysis, which are essential components in the data science workflow [41].

By offering a secure and transparent data storage and sharing system, block chain technology helps improve data science. It is one of the critical features of secure data management, which involves storing data across multiple nodes in a decentralized manner, minimizing the risk of data loss or corruption and access by unauthorized users [42]. Block chain is designed to ensure data integrity and trustworthiness as it cannot be changed once it's recorded. In fields like healthcare data analysis, financial forecasting, and government documents, this is especially crucial for ensuring data authenticity [43].

This integration enables the creation of reliable and transparent data analytics solutions. The combination of Block chain and AI offers an immutable chain of data sources and processing steps, ensuring intelligent analysis. They both increase transparency and enable stakeholders to assess the process of deriving insights and predictions [44]. There are also drawbacks to integration, including the limitations of scalability, the high cost of computation, data interoperability issues and latency in

block chain transactions. In addition, the deployment of sophisticated AI models in a distributed ledger system demands complex infrastructure and optimized processes [45].

AI & BLOCK CHAIN IN COMPUTER VISION

Combining Artificial Intelligence (AI) and block chain in computer vision is a major step towards creating intelligent, secure, and trustworthy visual data systems. Computer vision is a field of AI which involves machines interpreting and understanding visual data from their surroundings, including images and videos. It plays a crucial role in applications like autonomous vehicles, medical imaging, surveillance systems, robotics, and biometric authentication [46]. Block chain can introduce data integrity, security, and traceability to these systems, while AI can analyze and interpret visual data.

Deep learning methods, specifically Convolutional Neural Networks (CNNs), play a crucial role in computer vision applications, as they are trained to automatically learn features from images and videos. They are commonly applied in image classification tasks, such as object or category recognition in images, like detecting diseases in medical imaging or objects in an autonomous driving environment. One of the most common uses is object detection, which uses a single image or frame to detect and identify multiple objects [47]. This is common for use in surveillance and traffic monitoring systems. Another important task is image segmentation, where images are divided into meaningful segments to analyze objects at a pixel level, which is widely applied in medical diagnostics and scene understanding. Besides, Computer Vision techniques are used in facial recognition and biometric systems for identity verification in security, smart-phones and access control applications [48].

Block chain technology enhances computer vision systems by ensuring secure and tamper-resistant storage and sharing of visual data. One of the main challenges in computer vision is ensuring the authenticity and integrity of datasets used for training AI models. Block chain fixes this by storing image and video data in an unalterable ledger, where data cannot be tampered with or altered. This is especially crucial for sensitive applications like autonomous systems, healthcare imaging, and law enforcement, where data reliability is paramount [49].

Additionally, block chain is integral to safeguarding visual information by replicating images and videos across several nodes instead of central servers, ensuring decentralized storage. This helps to minimize the potential threat of data breaches and unauthorized access. Moreover, AI-block chain-based vision systems are possible, where an AI system analyses visual information and a block chain system logs every transaction, prediction, and access to the data [50]. This will help to ensure transparency and accountability in the decision making process.

COMPARATIVE ANALYSIS AND DISCUSSION

The application of Artificial Intelligence (AI) and block chain integration in healthcare, electrical systems, data science, and computer vision serves as a comparative study of their strengths and weaknesses, as well as their differences and similarities in these distinct fields. The use of AI and block chain in each domain is unique, but the common thread is the desire to boost efficiency, bolster data security, refine decision-making processes, and foster trust in digital systems [51].

AI, in all four domains, mainly adds intelligent data processing, prediction and automation. But there are significant differences in the kind of data and the kind of AI applications. Healthcare is just one industry where AI is addressing sensitive data, such as medical records, for diagnosis, disease prediction, and tailored treatment options [52]. AI is more focused on time-series data, like energy usage trends and grid performance, in electrical systems, where it aids in load forecasting and fault detection. While Data Science is an analytical machine that can process a massive amount of structured and unstructured data, Computer Vision uses AI via a deep learning model for image and video processing and interpretation. However, AI remains the backbone of analysis across the board [53].

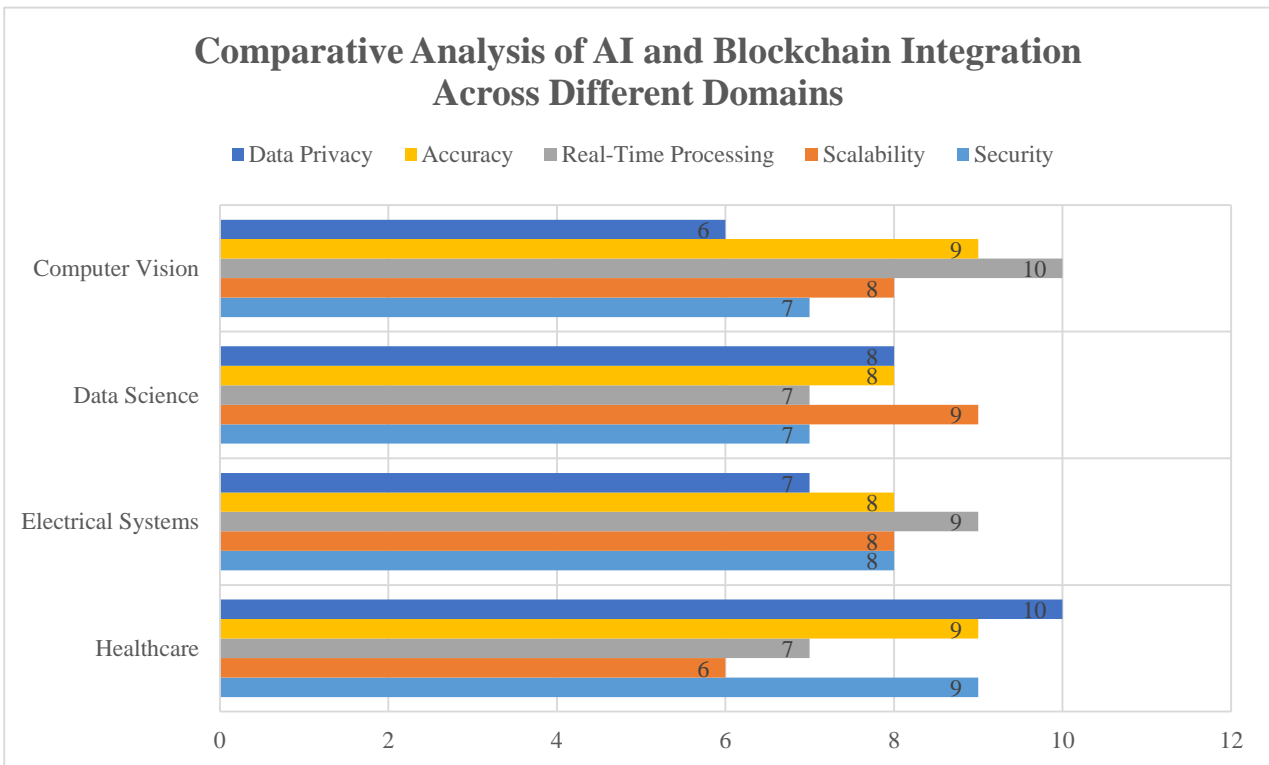


Figure 2. Comparative Analysis of AI and Block chain Integration across Different Domains

It supports decentralized energy trading and smart metering in electrical systems. Block chain can be used to facilitate secure data sharing and federated learning approaches in data science. It provides authenticity of image and video datasets for computer vision applications and audit trails for visual

data processing in computer vision. In this sense, block chain can be called the trust layer, and AI can be called the Intelligence layer [54]. In terms of performance, explainable AI and secure block chain systems become critical for healthcare systems, where accuracy and privacy are paramount. In electrical systems, real-time processing, scalability, and energy efficiency are important, rendering latency an critical factor. Data science applications are designed to work with large volumes of data, so they need to be efficient in their processing and have strong data governance measures. In order to meet the real-time inference requirement of computer vision systems, computational optimization is an essential requirement. These varying priorities lead to different design choices in AI–block chain integration for each domain [55].

The comparative analysis also identifies important areas of research that are missing. There is a big challenge on the lack of uniformity in different fields in terms of the frameworks for the integration of AI with block chain. Another is the lack of capacity for real-time processing over scales in current systems, especially in electrical systems and computer vision [56]. Moreover, ethical issues like data ownership, algorithmic bias, and regulatory compliance issues are yet to be answered in every domain. The fusion of AI and block chain technology holds significant promise in various sectors but may not be a suitable fit in every context or scenario. To build the next generation of intelligent systems that are balanced and take scalability, security, efficiency and ethical responsibility into account [57].

CHALLENGES AND OPEN RESEARCH ISSUES

Although there is a tremendous effort to incorporate Artificial Intelligence (AI) and block chain in various fields like healthcare, electrical systems, data science, computer vision and many others, there are still certain challenges and open research issues that need to be addressed to ensure adoption and large scale implementation. The challenges cover the technical, operational, ethical and regulatory aspects and are an ongoing research area [58].

Computation is one of the most important difficulties. Deep learning architectures, such as AI models, demand large amounts of computational resources for training and inference. Likewise, block chain networks are characterized by computational-intensive cryptographic operations, consensus mechanisms, and distributed validation processes. If both technologies are combined, the overall system complexity becomes very high, resulting in higher processing needs and system performance loss [59].

Another roadblock is interoperability. In real-life situations, systems and platform can be built with various frameworks, protocols, and standards. The challenge lies in making the heterogeneous systems work together in a coherent system, with standardized interfaces and communication

protocols. There are no standard rules, which hinders adoption and reduces cross-platform compatibility. Another factor to consider is the potential for scalability issues [60]. One of the drawbacks of block chain networks is that certain ones, particularly those employing the traditional consensus method like Proof of Work, face challenges in terms of their effectiveness and efficiency at handling large volumes of transactions. This is a key constraint in systems with a high requirement for data processing speed, like smartgrids, real-time health monitoring systems, or high-speed computer vision systems. Likewise, scaling AI applications to scale and perform efficiently on decentralized block chain networks adds extra overhead [61].

The adoption is further complicated by regulatory and ethical issues. There are different laws and regulations concerning data privacy, AI usage, and block chain financial or healthcare systems implemented in different countries. Compliance with legislation, including data protection policies, and preventing systems from becoming non-functional is a challenging process. Issues of algorithmic bias, fairness, accountability and transparency in AI decision making are also not resolved [62]. Integration with other systems is a constant challenge. Creating architectures that seamlessly integrate AI's learning power with block chain's decentralized nature demands cutting-edge engineering methods, optimized algorithms, and robust infrastructure support [63].

In conclusion, the integration of AI and block chain presents great potential, but it also comes with its fair share of hurdles. In summary, the convergence of AI and block chain technologies is a game-changer with significant potential, but it also has its challenges, which warrant ongoing research and innovation. The ability of solving these open issues is crucial for the development of scalable, secure, efficient, and morally responsible intelligent systems that can be applied in various real world systems [64].

FUTURE RESEARCH DIRECTIONS

AI and block chain integration is still in its infancy and has a lot of potential research areas. In an era when industries are turning to intelligent and decentralized systems, fresh possibilities are cropping up to boost performance, scalability, security and transparency in healthcare, electrical systems, data science, and computer vision. Future research is anticipated to include a focus on addressing current limitations and take advantage of new capabilities via advanced hybrid technology [65].

The fusion of quantum computing with block chain and AI is also a growing trend. The potential impact of quantum computing on AI model training and optimization problems is significant. Meanwhile, it brings difficulties to the traditional block chains cryptographic approaches. The researchers' work will continue with the aim of creating quantum-resistant block chain algorithms and applying quantum AI models to enhance speed and security in calculations [66]. Edge AI and

Internet of Things (IoT) are also important avenues of research that integrate with block chain. As the number of IoT devices continues to grow, producing a lot of real-time data, edge AI enables processing near the point of data generation, minimizing latency and bandwidth consumption. Together with the block chain technology, it allows for secure, decentralized and real-time decision making systems, relevant in smart cities, autonomous vehicles and healthcare monitoring systems [67].

Another key area is the integrated design of Green and Sustainable AI–block chain systems. Both AI and block chain have the potential to consume a significant amount of energy, and future studies will investigate ways to optimize algorithms to save energy. This includes developing lightweight consensus mechanisms, energy-efficient AI models, and hybrid architectures that minimize environmental impact while maintaining performance [68]. The development of explainable and trustworthy AI ecosystems is also a key focus area. With the increasing integration of AI with block chain, transparency in decision-making is crucial. Traceability of AI model training and predictions on block chain will enable transparency, and explainable AI techniques will help users understand how decisions are made, fostering trust in critical use-cases like healthcare and finance [69].

The future of block chain and AI integration will be studied with a focus on interoperability across various block chain networks and AI systems. Standardized procedures will facilitate the smooth interconnection of systems and facilitate their widespread use in industry. This will enable cross domain applications with the ability to share data and intelligence securely across multiple platforms [70]. The future of AI and block chain integration is about to be shaped by the development of smart, decentralized, secure and eco-friendly systems. Future research in these areas is set to be crucial in the development of technologies that can solve complex challenges in multi-domain scenarios of the future [71].

CONCLUSION

Block chain and Artificial Intelligence (AI) are two of the most groundbreaking advancements in the field of computing that are poised to transform the way data is processed, secured, and put into use in numerous fields. The review has covered the basics of AI–block chain systems, integration approaches, applications, challenges and future prospects in healthcare, electrical systems, data science and computer vision. In total, these chats underscore what the synergy between AI and block chain is, not simply a step forward, but a cornerstone of the development of future intelligent and trustworthy digital environments.

Artificial Intelligence provides the capability to learn from data, detect patterns, and make decisions based on that learning, using machine learning, deep learning, and reinforcement learning. These

capabilities provide automation, prediction and optimization in complex environment. But AI systems are not always transparent, can be manipulated by data and rely on centralised data sets. Block chain technology is uniquely able to solve these problems with its decentralized, immutable and transparent data management. The combination of its core strengths of security, traceability and trust with the intelligence of AI is a perfect match.

From healthcare, AI is improving diagnosis, medical imaging, drug discovery and monitoring, and block chain providing secure storage and sharing of sensitive health information. AI can enhance the efficiency of electrical systems, predict faults and optimize energy usage, while block chain can facilitate secure peer-to-peer energy transactions and decentralize energy management. AI facilitates the creation of sophisticated models and predictive data analysis, and block chain guarantees data security and privacy, with federated learning being one of the many techniques. In the field of data science, AI enables powerful data analysis and predictive modeling, while block chain ensures data integrity and secure sharing with federated learning being one of the techniques used for privacy. AI can be used to recognize images, detect objects, and authenticate users through biometric features in computer vision, while block chain ensures the integrity and provenance of visual information.

Combination of these technologies results in intelligent system that is also secure and transparent. There are several potential challenges, such as: limitations to scalability, high computational costs, interoperability problems, regulatory issues, and ethical concerns like bias and data privacy. Moreover, some block chain processes and the technological complexity of implementing distributed systems with AI models pose significant technical challenges. Research efforts are continuous in overcoming these challenges, with new advancements like edge computing, federated learning, block chain with quantum resistance, explainable AI, and eco-friendly consensus mechanisms. These developments are expected to bring a great improvement to the performance, scale and usability of AI-block chain integrated systems.

AI and block chain integration is paving the way for a new generation of intelligent, decentralized, and trustworthy systems. Together, they have great promise in reshaping the future of key industries through their ability to enhance decision-making, secure data, and streamline transparent automation. This convergence is likely to be a key enabling technology for the digital future, and as research advances it will be used to facilitate innovations across fields and make global systems more secure, efficient, and intelligent.

REFERENCES

- [1]. Rane N, Choudhary S, Rane J. Blockchain and Artificial Intelligence (AI) integration for revolutionizing security and transparency in finance. Available at SSRN 4644253. 2023 Nov 17.
- [2]. Chaudjary S, Kakkar R, Gupta R, Tanwar S, Agrawal S, Sharma R. Blockchain and federated learning-based security solutions for telesurgery system: a comprehensive review. *Turkish Journal of Electrical Engineering and Computer Sciences*. 2022;30(7):2446-88
- [3]. Jamshaid M, Muhammad AH, Akbar Z, Niaz S, Siddique MN, Akbar S. Artificial intelligence generated deepfakes as instruments of disinformation: Examining their influence on public opinion, digital trust, and governance. *Journal of Information Systems Engineering and Management*. 2025;10.
- [4]. Khatri S, Alzahrani FA, Ansari MT, Agrawal A, Kumar R, Khan RA. A systematic analysis on blockchain integration with healthcare domain: scope and challenges. *IEEE Access*. 2021 Jun 9;9:84666-87.
- [5]. Singh A. Fifty Years of Computer Science: Trends, Milestones, and Emerging Challenges. *Global Research Repo*. 2025 Sep 9;1(2):230-53.
- [6]. Khan IU, Ouaisa M, Ouaisa M, Fayaz M, Ullah R, editors. *Artificial intelligence for intelligent systems: fundamentals, challenges, and applications*.
- [7]. Oad VD. *Intelligent Data Analytics: A Review of AI-Based Approaches*. *Global Journal of Multidisciplinary Sciences and Arts*. 2025;2(2):153-75.
- [8]. Rao KP, Manvi S. Survey on electronic health record management using amalgamation of artificial intelligence and blockchain technologies. *Acta Informatica Pragensia*. 2023 Apr 19;12(1):179-99.
- [9]. Zatsu V, Shine AE, Tharakan JM, Peter D, Ranganathan TV, Alotaibi SS, Mugabi R, Muhsinah AB, Waseem M, Nayik GA. Revolutionizing the food industry: The transformative power of artificial intelligence-a review. *Food Chemistry: X*. 2024 Dec 30;24:101867.
- [10]. Erdenetsogt T, Jamal M. Machine Learning for Big Data Analytics: A Comprehensive Review. *Global Trends in Science and Technology*. 2026 Apr 25;2(2):199-218.
- [11]. Singh A. Artificial Intelligence in Computer Science and Machine Learning: Advancing Data Analytics. *Global Journal of STEM and Society*. 2026 Feb 6;1(1):92-106.
- [12]. Abdelhamid M, Sliman L, Ben Djemaa R, Perboli G. A review on blockchain technology, current challenges, and AI-driven solutions. *ACM Computing Surveys*. 2024 Nov 22;57(3):1-39.

- [13]. Poikaryil OB, Babu TB, Sagar G, Krishna V, Mitra S. Transformative fusion: Leveraging blockchain and AI for educational data analytics in modern education systems. In *Blockchain and AI in shaping the modern education system 2025* May 21 (pp. 182-208). CRC Press.
- [14]. Akter S, Michael K, Uddin MR, McCarthy G, Rahman M. Transforming business using digital innovations: The application of AI, blockchain, cloud and data analytics. *Annals of Operations Research*. 2022 Jan;308(1):7-39.
- [15]. Jabbar R, Dhib E, Said AB, Krichen M, Fetais N, Zaidan E, Barkaoui K. Blockchain technology for intelligent transportation systems: A systematic literature review. *IEEE Access*. 2022 Feb 7;10:20995-1031.
- [16]. Chamola V, Hassija V, Gupta V, Guizani M. A comprehensive review of the COVID-19 pandemic and the role of IoT, drones, AI, blockchain, and 5G in managing its impact. *Ieee access*. 2020 May 4;8:90225-65.
- [17]. Shehzad K, Munir A, Ali U. AI-powered food contaminant detection: a review of machine learning approaches. *Global Journal of Computer Sciences and Artificial Intelligence*. 2025;1(2):1-22.
- [18]. HASSAAN A, AKBAR Z, JAMSHAD MM, NIAZ S, AKBAR S, SIDDIQUE MN, TABASAM AH. AI-driven administrative automation: Enhancing operational efficiency and security. *TPM–Testing, Psychometrics, Methodology in Applied Psychology*. 2025 Oct 10;32(S7 (2025): Posted 10 October):2451-60.
- [19]. Roumeliotis C, Dasygenis M, Lazaridis V, Dossis M. Blockchain and digital twins in smart industry 4.0: The use case of supply chain-a review of integration techniques and applications. *Designs*. 2024 Oct 23;8(6):105.
- [20]. Satpathy S, Khalaf O, Kumar Shukla D, Chowdhary M, Algburi S. A collective review of Terahertz technology integrated with a newly proposed split learningbased algorithm for healthcare system.
- [21]. Mahmood MR, Matin MA, Sarigiannidis P, Goudos SK. A comprehensive review on artificial intelligence/machine learning algorithms for empowering the future IoT toward 6G era. *IEEE access*. 2022 Aug 18;10:87535-62.
- [22]. Singh A. Data-Driven Intelligence: Emerging Architectures for Scalable and Responsible AI Systems. *Global Trends in Science and Technology*. 2026 May 1;2(2):240-62.
- [23]. Safitra MF, Lubis M, Kusumasari TF, Putri DP. Advancements in artificial intelligence and data science: models, applications, and challenges. *Procedia Computer Science*. 2024 Jan 1;234:381-8.

- [24]. Verma A. Integration of Artificial Intelligence and Blockchain for Hybrid Intelligent Systems With Innovations, Applications, and Future Directions. In AI and Blockchain Applications in the Oil and Gas Industry 2026 (pp. 171-206). IGI Global Scientific Publishing.
- [25]. Kabeer MM. AI in Lean Six Sigma: A Review of Industrial Implementations, Benefits, and Barriers. *Global Journal of Multidisciplinary Sciences and Arts*. 2024 Dec 13;1(2):134-58.
- [26]. Jamal M, Aslam MS. From Data to Decisions: AI-Driven Machine Learning in Modern Healthcare. *Global Journal of Multidisciplinary Sciences and Arts*. 2025;2(2):115-32.
- [27]. Salah K, Rehman MH, Nizamuddin N, Al-Fuqaha A. Blockchain for AI: Review and open research challenges. *IEEE access*. 2019 Jan 1;7:10127-49.
- [28]. Kabeer MM. Synergizing AI and Lean Six Sigma: A Comprehensive Review of Smart Quality Assurance Systems. *Global Journal of Multidisciplinary Sciences and Arts*. 2024 Dec 12;1(2):113-33.
- [29]. Singh A. Intelligent Machines: Shaping the Future of Computer Science and Society. *Global Research Repo*. 2025 Sep 9;1(2):254-78.
- [30]. Chhetri KB. Applications of artificial intelligence and machine learning in food quality control and safety assessment. *Food Engineering Reviews*. 2024 Mar;16(1):1-21.
- [31]. Mozumder MA, Sheeraz MM, Athar A, Aich S, Kim HC. Overview: Technology roadmap of the future trend of metaverse based on IoT, blockchain, AI technique, and medical domain metaverse activity. In 2022 24th international conference on advanced communication technology (ICACT) 2022 Feb 13 (pp. 256-261). IEEE.
- [32]. Singh A. A Survey of Foundational Concepts and Emerging Frontiers in Computer Science. *Global Research Repo*. 2025 Sep 9;1(2):279-309.
- [33]. Javed AR, Hassan MA, Shahzad F, Ahmed W, Singh S, Baker T, Gadekallu TR. Integration of blockchain technology and federated learning in vehicular (iot) networks: A comprehensive survey. *Sensors*. 2022 Jun 10;22(12):4394.
- [34]. Neoaz N, Bacha A, Khan M, Sherani AM, Shah HH, Abid N, Amin MH. AI in Motion: Securing the Future of Healthcare and Mobility through Cybersecurity. *Asian Journal of Engineering, Social and Health*. 2025 Jan 29;4(1):176-92.
- [35]. Khan F. Neural Networks in Electrical Engineering Applications: A Review. *Global Trends in Science and Technology*. 2026 Apr 29;2(2):219-39.
- [36]. Mohammed M, Kunnipurayil S. Automation and Smart Manufacturing in Medical Device Production. *Global Journal of Multidisciplinary Sciences and Arts*. 2025;2(2):176-202.

- [37]. Kabeer MM. AI in Manufacturing Quality Management: A Review of Techniques, Tools, and Industrial Adoption. *Global Journal of Multidisciplinary Sciences and Arts*. 2024 Dec 11;1(2):46-64.
- [38]. Chataut R, Phoummalayvane A, Akl R. Unleashing the power of IoT: A comprehensive review of IoT applications and future prospects in healthcare, agriculture, smart homes, smart cities, and industry 4.0. *Sensors*. 2023 Aug 16;23(16):7194.
- [39]. Oad VD. Artificial Intelligence for Big Data Analytics: A Review of Trends and Challenges. *Global Trends in Science and Technology*. 2026 Mar 20;2(2):83-102.
- [40]. Kabeer MM. Quality by Intelligence: A Review of AI Applications in Healthcare Product Lifecycle Management. *Global Research Repo*. 2025 Nov 30;1(4):126-47.
- [41]. Bourechak A, Zedadra O, Kouahla MN, Guerrieri A, Seridi H, Fortino G. At the confluence of artificial intelligence and edge computing in iot-based applications: A review and new perspectives. *Sensors*. 2023 Feb 2;23(3):1639.
- [42]. Raza H, Erdenetsogt T, Singh A, Farooq M, Kabeer MM, Aslam MS. A Comprehensive Review on Data Science Frameworks for Big Data Analytics. *PERFECT: Journal of Smart Algorithms*. 2026 Jan 6;3(1):1-0.
- [43]. Jamal A, Raza H, Erdenetsogt T, Singh A, Farooq M, Kabeer MM, Aslam MS. AI and Data Analytics for Precision Agriculture: Current Progress and Future Directions. *JATAED: Journal of Appropriate Technology for Agriculture, Environment, and Development*. 2025 Aug 15;2(2):36-46.
- [44]. Khan M, Bacha A. AI-Driven Cybersecurity in Healthcare: The Transformative Potential of Generative AI. *Global Research Repo*. 2025 Nov 3;1(3):157-81.
- [45]. Bacha A, Sherani AM. AI in Predictive Healthcare Analytics: Forecasting Disease Outbreaks and Patient Outcomes. *Global Trends in Science and Technology*. 2025 Jan 24;1(1):1-4.
- [46]. Kabeer MM. Utilizing Machine Learning for Continuous Process Improvement in Lean Six Sigma. *Global Trends in Science and Technology*. 2025 May 7;1(2):49-63.
- [47]. Al-Nbhany WA, Zahary AT, Al-Shargabi AA. Blockchain-IoT healthcare applications and trends: A review. *IEEE Access*. 2024 Jan 2;12:4178-212.
- [48]. Oad SK. Recent Advances in Artificial Intelligence for Data Science: A Review. *Global Journal of Multidisciplinary Sciences and Arts*. 2025;2(2):133-52.
- [49]. Jagatheesaperumal SK, Rahouti M, Ahmad K, Al-Fuqaha A, Guizani M. The duo of artificial intelligence and big data for industry 4.0: Applications, techniques, challenges, and future research directions. *IEEE Internet of Things Journal*. 2021 Dec 31;9(15):12861-85.

- [50]. Khan AA, Yang J, Awan SA, Baqasah AM, Alroobaea R, Chen YL, Ku CS, Por LY. Artificial intelligence, internet of things, and blockchain empowering future vehicular developments: A comprehensive multi-hierarchical lifecycle review. *Human-centric Computing and Information Sciences*. 2025 Mar 15;15(1):1-32.
- [51]. Fadhel MA, Duhaim AM, Albahri AS, Al-Qaysi ZT, Aktham MA, Chyad MA, Abd-Alaziz W, Albahri OS, Alamoodi AH, Alzubaidi L, Gupta A. Navigating the metaverse: unraveling the impact of artificial intelligence—a comprehensive review and gap analysis. *The Artificial Intelligence Review*. 2024 Sep 1;57(9):264.
- [52]. Kunnipurayil S, Mohammed M. Advanced Manufacturing and Process Optimization in Medical Device Production. *Global Trends in Science and Technology*. 2026 Apr 16;2(2):175-98.
- [53]. Nguyen DC, Ding M, Pathirana PN, Seneviratne A. Blockchain and AI-based solutions to combat coronavirus (COVID-19)-like epidemics: A survey. *Ieee Access*. 2021 Jun 30;9:95730-53.
- [54]. Khan F. Optimization of Power Systems Using AI: A Review of Modern Approaches. *Global Journal of Multidisciplinary Sciences and Arts*. 2025;2(2):203-24.
- [55]. Singh A. Cross-Domain Trust-Aware Artificial Intelligence for Behavioral Risk Prediction in Pediatric Healthcare, Financial Systems, and Public Decision Environments. *Frontiers in Computer Science and Artificial Intelligence*. 2025 Dec 28;4(1):07-12.
- [56]. Gangwani P, Perez-Pons A, Joshi S, Upadhyay H, Lagos L. Integration of data science and IoT with blockchain for industry 4.0. In *Blockchain and its Applications in Industry 4.0 2023* Mar 10 (pp. 139-177). Singapore: Springer Nature Singapore.
- [57]. Kabeer MM. AI and Machine Learning in Lean Six Sigma: A Comprehensive Review of the Future of Process Excellence. *Global Research Repo*. 2025 Nov 26;1(4):104-25.
- [58]. Singh A. Advancing Healthcare through AI-Driven Data Analytics: Integrating Machine Learning and Cybersecurity in Modern Computer Science. *Global Journal of STEM and Society*. 2026 Feb 6;1(1):107-26.
- [59]. Padma A, Ramaiah M, Ravi V. A comprehensive review of lightweight blockchain practices for smart cities: A security and efficacy assessment. *Journal of Reliable Intelligent Environments*. 2025 Sep;11(3):13.
- [60]. Oad SK. Integration of AI in Data Science: A Systematic Review. *Global Trends in Science and Technology*. 2026 Mar 18;2(2):64-82.

- [61]. Rane NL, Paramesha M, Choudhary SP, Rane J. Artificial intelligence, machine learning, and deep learning for advanced business strategies: a review. *Partners Universal International Innovation Journal*. 2024 Jun 25;2(3):147-71.
- [62]. Bacha A, Shah HH, Abid N. The Role of Artificial Intelligence in Early Disease Detection: Current Applications and Future Prospects. *Global Journal of Emerging AI and Computing*. 2025 Jan 20;1(1):1-4.
- [63]. Rahman A, Kundu D, Debnath T, Rahman M, Islam MJ. Blockchain-based AI methods for managing industrial IoT: recent developments, integration challenges and opportunities. *arXiv preprint arXiv:2405.12550*. 2024 May 21.
- [64]. Kabeer MM. Artificial Intelligence in Modern Manufacturing: Opportunities and Barriers. *Global Trends in Science and Technology*. 2025 Jul 16;1(3):83-100.
- [65]. Punitha S, Preetha KS. Unleashing potential: a deep dive into AI-blockchain integration for UAV-enhanced tele-surgery. *Cogent Engineering*. 2024;11(1).
- [66]. Shah HH, Bacha A. Leveraging AI and Machine Learning to Predict and Prevent Sudden Cardiac Arrest in High-Risk Populations. *Global Journal of Universal Studies*. 2024 Dec 15;1(2):87-107.
- [67]. Rana SK, Rana SK, Nisar K, Ag Ibrahim AA, Rana AK, Goyal N, Chawla P. Blockchain technology and artificial intelligence based decentralized access control model to enable secure interoperability for healthcare. *Sustainability*. 2022 Aug 2;14(15):9471.
- [68]. Sheraz M, Chuah TC, Lee YL, Alam MM, Al-Habashna AA, Han Z. A comprehensive survey on revolutionizing connectivity through artificial intelligence-enabled digital twin network in 6G. *IEEE Access*. 2024 Apr 3;12:49184-215.
- [69]. Bakhouch SM, Sahraoui S. Combining Artificial Intelligence and Blockchain Technology in the Context of the Internet of Things (IoT): A Review. In *2025 International Symposium on iNnovative Informatics of Biskra (ISNIB) 2025 Jan 28 (pp. 1-6)*. IEEE.
- [70]. Robert W, Denis A, Thomas A, Samuel A, Kabiito SP, Morish Z, Ali G. A comprehensive review on cryptographic techniques for securing internet of medical things: A state-of-the-art, applications, security attacks, mitigation measures, and future research direction. *Mesopotamian Journal of Artificial Intelligence in Healthcare*. 2024 Nov 3;2024:135-69.
- [71]. Ali MA. A Broad Review of AI and Machine Learning in Healthcare Informatics for Predictive Analytics, Data Analytics, and Healthcare Supply Chain Systems. *Global Trends in Science and Technology*. 2026 Mar 18;2(2):43-63.