

The Intersection of AI and Blockchain in Digital Identity Verification Systems

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ABSTRACT:

This paper is dedicated to the Artificial Intelligence (AI) and Blockchain-based solution in digital identity verification. Blockchain offers secure and immutable storage of any data, and AI enhances accuracy and efficiency because of more advanced data analysis and detection of abnormalities. They are combinedly employed to eliminate central points of failure, improve authentication and protect privacy. However, concerns like regulatory challenges, interoperability of technology and ethics are prevailing. In the conclusion of the paper, it is stated that AI and Blockchain can change a lot but certain further developments and consideration of privacy and regulatory challenges need to be implemented until such technologies can become mainstream.

Keywords: Artificial Intelligence, Blockchain, Digital Identity, Verification Systems, Security Ledger Technology (DLT), Financial Privacy.

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I. Introduction

AI and blockchain are changing digital identity verification to provide greater security in the face of increasing cyber risks and overcoming the shortcomings of the traditional schemes (Liu et al., 2023). The vulnerabilities of the conventional identity verification systems that lie in their central database-driven character and the utilization of physical documents are currently creating a severe

issue as they predispose these systems to cyberattacks, fraud, and identity theft, which is why there is a need to present more resilient digital identity management systems (Periyasamy et al., 2024). Bitcoin technology can ensure the integrity of digital data, but AI can turn the data into smarter data, which can lead to increased security and higher productivity; AI

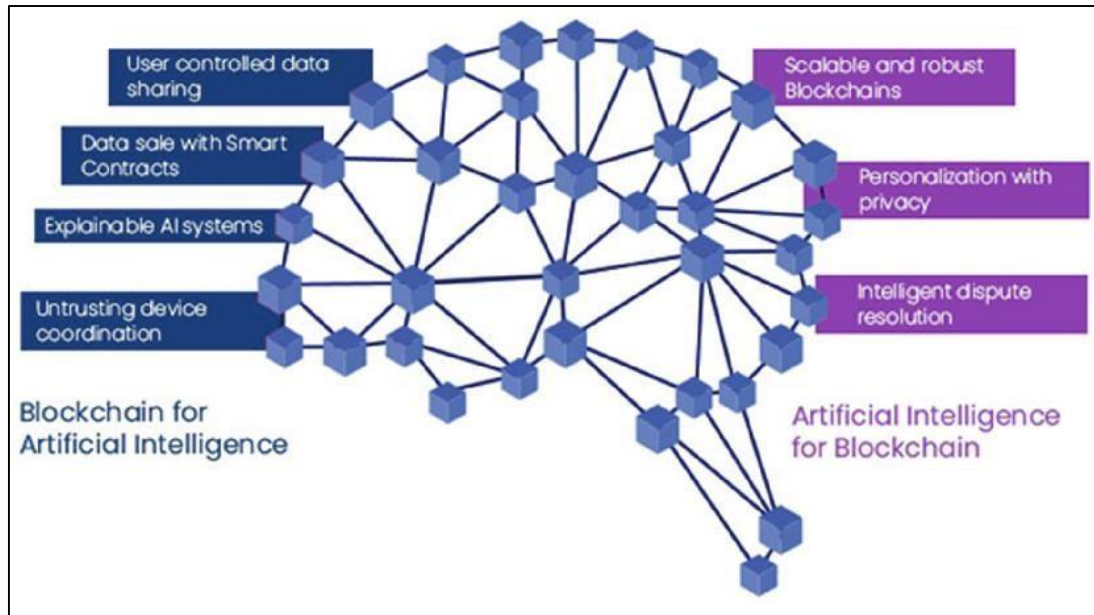


Figure 1: Blockchain vs AI in Digital Identity Verification

Information about the study background

Technology, artificial intelligence and agriculture can support areas likely to experience hunger due to climate change through a new method of resource management (Dhal & Kar, 2024). The age of the Fourth Industrial Revolution has enhanced the precise use of resources in farming. Using input from satellites, IoT devices, historic weather records and AI, we are able to aid food security when planning agriculture (Kumar et al., 2023). They help produce more food, defend crops and ensure there is enough to eat as climate change and a rising population affect us (Javaid et al., 2022; Naresh et al., 2020). AI provides tools that let people easily manage their what they like when they shop for food. The initial measurement of carcass quality uses AI, mass spectrometry and hyperspectral imaging and proves to be highly effective (william, 2025). AI makes it less difficult for stakeholders to plan, use their resources economically and choose actions for sustainable farming and greater food security (Almoselhy & Usmani, 2024; Taddeo et al., 2021). Because of climate issues, several smallholder farmers in Sub-Saharan Africa, South Asia and Latin America are immediately in need of support

Background of the Study

Blockchain and artificial intelligence are changing the digital identity verification systems since they address the inherent vulnerabilities of their

to help many people (Aijaz et al., 2025). Artificial intelligence can raise the tolerance of crops to changes in their environment (Khan et al., 2022). Through AI, nutrition problems in plants are found and solved which supports better production of crops and reduces food waste (according to Aijaz et al. in 2025). When data is involved, AI in agriculture can lead to greater productivity, better care for the environment and stronger farm resilience to changes in the climate. As a result, taking care of your animals becomes much easier (Sidhu et al., 2021). AI tells small scale farmers when to plant, how to save on water and how to deal with pests—all these choices save resources and help produce more food. Thanks to AI, farmers are able to use useful financial services, study market trends and receive guidance on how to improve their farming. The use of AI improves waste management which plays a big role in safeguarding both sustainability and resources. When data from waste streams is handled by artificial intelligence, sorting is improved, collection happens less and better routes are planned, saving money and helping the environment (Naveenkumar et al., 2023).

predecessors (Shanmugam et al., 2023). The conventional systems built on central databases, and configured to rely on passwords to establish

user identity, are becoming extremely vulnerable to data exposure, single points of failure, and sophisticated variations of impersonation attacks (Adel, 2024). Blockchain with its decentralized and immutable registry promises a novel effective scheme of managing digital identities, empowering individuals in the control of their personal data and minimizing threats of its unauthorized modification or disclosure (Periyasamy et al., 2024). Machine learning, facial

Justification

The overlap of artificial intelligence and blockchain technology is a generational opportunity to redesign the identity verification system and eliminate critical vulnerabilities of the old models. Central databases and manual verifications are the typical forms of the conventional methods of identity verification, which are inefficient, susceptible to breaches, and fraud-prone (Adel, 2024). It is possible to say that AI and blockchain may be used together to offer a decentralized secure and transparent system that

Objectives of the Study

1. To address how AI and Blockchain may provide assistance in ensuring that the digital identity verification process is safer and more effective.
2. To explore the idea of AI algorithms and Blockchain technology using in verification of digital identities.

Literature Review

Artificial Intelligence and blockchain technologies are at the crossing of a new paradigm of enhancing the digital identity verification system with transparency, security, and efficiency unprecedented before (Liu et al., 2023). Blockchain immutability and decentralized nature provide a safe foundation of storing and semi-controlling digital identities, making the vulnerability of central databases. That is done through cutting-edge cryptography and decentralized data systems to form digital trust (Periyasamy et al., 2024). Specifically, being mathematical tools, hash functions play a vital role in data authentication, creating a unique identifier that ensures data integrity by detecting

recognition and behavior biometrics are the AI technologies which complement the identity verification procedure by conducting complex calculations, sorting through volumes of data to identify anomalies and enhancing the authentication systems accuracy (Mandru, 2022). By using a combination of these technologies, one can take a sneak peek at a secure, transparent and privacy-preserving digital identity ecosystem (Ruzbahani, 2024).

will make a significant change regarding accuracy, privacy, and efficiency of identity management (Mandru, 2022). Blockchain as a technology has immutability and cryptographic security, which forms a solid foundation of storage and preservation of digital identities (Chang & Lund, 2025). This is because the blockchain stores every identity as a transaction, creating an audit-able, tamper-evident history of identity attributes and verification events (Ruzbahani, 2024).

3. To examine the weakness and disadvantages of AI and Blockchain applications in digital identity verification.
4. To analyse ethical, legal and privacy implications of AI and Blockchain-based digital identity systems.
5. To identify potential solutions that would serve as the barrier-breakers to AI and Blockchain application in identity verification.

a modification in the record of information (Periyasamy et al., 2024). Meanwhile, AI algorithms apply their analytical potential to operate big amounts of data, discover Abnormalities, and verify persons with a high accuracy rate (Chang & Lund, 2025). AI capabilities of extracting reasonable patterns and trends out of the data landscapes of great complexity improve fraud detection and identity verification processes considerably. Some of the AI-based biometrics currently actively becoming a significant part of a digital identity system are facial recognition and fingerprint scanning since they enable authentication to happen seamlessly and securely (Periyasamy et al., 2024).

AI Technique	Description	Application in Identity Verification	Advantages	Challenges
Facial Recognition	Uses AI algorithms to analyze and verify facial features.	Used for biometric authentication in online and offline systems.	High accuracy, fast processing.	Privacy concerns, biased algorithms.
Fingerprint Recognition	Analyzes unique patterns in fingerprints for identification.	Common in smartphones and secure access systems.	Secure, hard to replicate.	Vulnerable to spoofing, requires high-quality sensors.
Behavioral Biometrics	Analyzes user behavior patterns (typing, mouse movements).	Used in continuous authentication during online transactions.	Continuous authentication, non-invasive.	Privacy concerns, needs large data sets for accurate analysis.
Voice Recognition	Identifies unique voice patterns for authentication.	Applied in call center verification and smart home devices.	Convenient, non-intrusive.	Susceptible to background noise, less accurate in noisy environments.

Table 1: AI Techniques in Digital Identity Verification

Material and Methodology

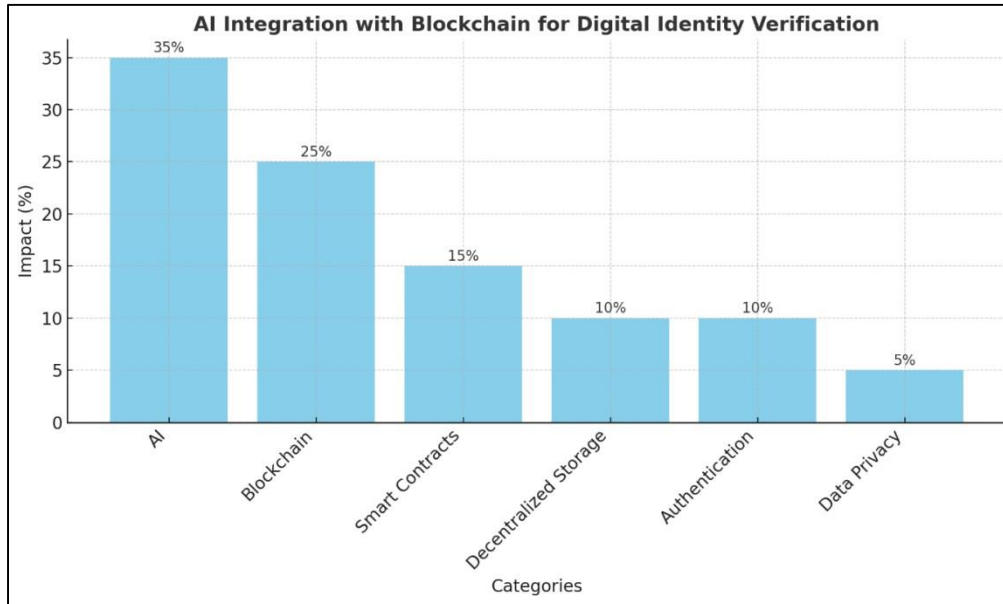
The article under discussion is a qualitative study which investigates the landscape of AI and Blockchain in digital identity verification systems through literature review of scholarly articles and research reports, and case studies. The objective of the study is to find significant technological achievements, shortcomings, and applications of

AI and Blockchain to identity verification. It is also possible to conduct expert stakeholders and field interviews which may offer some insights on real life implementations and challenges of these technologies. The paper also deals with regulation and ethics of AI and Blockchain use in digital identity management.

Discussion and Results

Digital identity verification can benefit a lot using AI and Blockchain. The distributed ledger provided by the blockchain technology provides a secure and transparent method of storing identity information since the information can not be altered without the consent of the network. This impossibility to change is very important in fraud and identity theft prevention. Rather than that, AI could enhance the verification process, researching the patterns and finding anomalies to flag a potential fraud alert in real-time. AI-based biometrics technologies, such as facial recognition and behavioral biometrics can be integrated with Blockchain to create a highly

flexible and yet incredibly secure identity verification system. These advantages aside, several challenges exist. Scalability problem is among the most crucial challenges related to blockchain since decentralization of this technology has the potential to reduce the transaction speed and make them more costly. In addition, AI algorithms require many data and computing facilities, which could become an obstacle to large-scale implementations. Ethical concerns, such as data privacy and possibility of AI bias, also ought to be managed to ensure that such systems will be just and will enhance equity



The following graph shows the intersection of AI and Blockchain in digital identity verification, where the significant parts are AI, Blockchain, smart

contracts, decentralized storage, authentication, and data privacy. The highest contribution is made by AI of 35 percent and then

Study Limitations

Along with the benefits, it is necessary to acknowledge the limitations that accompany this research to contextualize its results and define the methodology of the future research project (Chen, 2023). To begin with, existing literature and secondary data impose potential biases and constraints on the use (Abuhalimeh & Ali, 2023; Chen et al., 2023). It is constrained by the abilities and perceptions of the already published works that may not be relevant to the current changes and future tendencies in the actively evolving sphere of artificial intelligence and blockchain technology (Alsaleh, 2024). More than that, no primary research, especially, interviews with the industry professionals are

conducted, which constrains the depth of insights and opportunity to triangulate the findings with the real-life experiences (Assadullah, 2019). Even though the secondary data might provide an opportunity to observe a large landscape picture, it might critically fail to represent detail and contextual understanding which might be collected by communicating with the practitioners directly (Priya & Anusha, 2019). Both the AI and Blockchain technologies are dynamic to the extent that the findings presented in this paper will soon become obsolete and new events will unfold that will necessitate frequent checking and updating of information to be current (Rujel and Njoku, 2020).

Future Scope

The following research steps should, actually, be aimed at developing hybrid systems that would make it possible to synergetically increase the benefits of both Artificial Intelligence and blockchain technology so that they would surpass the possibilities of the current solution with its scalability, security, and privacy challenges (Choi & Kim, 2024). Such systems would integrate the benefits of AI in pattern matching and anomaly detection to make the identity verification processes

more effective and accurate, and immutable and distributed ledger technology blockchain could achieve the security and transparency of identity data (Liu et al., 2023). Specifically, the biometric data, e.g., face recognition or a fingerprint scan, might be processed with the help of AI algorithms and safely stored and controlled with the help of blockchain, creating a secure and reliable digital identity space. The study concerning the convergence of AI and blockchain with other emerging technologies like the Internet of

Things and 5G networks is significantly underestimated regarding its capabilities to yield

Conclusion

The applications of AI and Blockchain in digital identity verification can unleash massive security, efficiency and privacy in digital transactions. Despite the fact that the problem of scalability, computational power and regulatory concerns have yet to be addressed, the intersection of these

more efficient and secure systems in many fields of implementation (Chen, 2023).

technologies offer a hopeful solution in curbing the growing menace of identity theft and fraud. AI and Blockchain are relatively new and further research and development will be needed to achieve all the promises of utilizing these technologies to manage digital identity.

References

1. Adel, N. (2024). The Impact of Digital Literacy and Technology Adoption on Financial Inclusion in Africa, Asia, and Latin America. *Heliyon*, 10(24).
<https://doi.org/10.1016/j.heliyon.2024.e4095>
2. Al-Enizi, A. M., Mishra, S., & Baihan, A. (2024). Enhancing secure financial transactions through the synergy of blockchain and artificial intelligence. *Ain Shams Engineering Journal*, 15(6), 102733.
<https://doi.org/10.1016/j.asej.2024.102733>
3. Chang, H., & Lund, B. (2025). Bringing AI and Blockchain Synergy into Cyber Threat Intelligence Cycle. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.5191276>
4. Liu, W., He, Y., Dong, J., & Cao, Y. (2023). Disruptive technologies for advancing supply chain resilience. *Frontiers of Engineering Management*, 10(2), 360.
<https://doi.org/10.1007/s42524-023-0257-1>
5. Mandru, S. kanth. (2022). How AI can improve identity verification and access control processes. *Journal of Artificial Intelligence & Cloud Computing*, 1.
[https://doi.org/10.47363/jaicc/2022\(1\)e101](https://doi.org/10.47363/jaicc/2022(1)e101)
6. Pandl, K. D., Thiebes, S., Schmidt- Kraepelin, M., & Sunyaev, A. (2020). On the Convergence of Artificial Intelligence and Distributed Ledger Technology: A Scoping Review and Future Research Agenda [Review of On the Convergence of Artificial Intelligence and Distributed Ledger Technology: A Scoping Review and Future Research Agenda]. *arXiv (Cornell University)*. Cornell University.
<https://doi.org/10.48550/arxiv.2001.11017>
7. Paramesha, M., Rane, N., & Rane, J. (2024). Artificial intelligence, machine learning, deep learning, and blockchain in financial and banking services: a comprehensive review [Review of Artificial intelligence, machine learning, deep learning, and blockchain in financial and banking services: a comprehensive review]. *SSRN Electronic Journal*. RELX Group (Netherlands).
<https://doi.org/10.2139/ssrn.4855893>
8. Shanmugam, L., Tillu, R., & Jangoan, S. (2023). Privacy-Preserving AI/ML Application Architectures: Techniques, Trade-offs, and Case Studies. *Journal of Knowledge Learning and Science Technology* ISSN 2959-6386 (Online), 2(2), 398.
<https://doi.org/10.60087/jklst.vol2.n2.p420>
9. Chen, Y.-H. (2023). Integrating Explainable Artificial Intelligence and Blockchain to Smart Agriculture with Decision Making and Improved Security.
<https://doi.org/10.2139/ssrn.4446597>
10. Choi, N., & Kim, H. (2024). Technological Convergence of Blockchain and Artificial Intelligence: A Review and Challenges [Review of Technological Convergence of Blockchain and Artificial Intelligence: A Review and Challenges]. *Electronics*, 14(1), 84. Multidisciplinary Digital Publishing Institute.
<https://doi.org/10.3390/electronics14010084>
11. Liu, W., He, Y., Dong, J., & Cao, Y. (2023). Disruptive technologies for advancing supply chain resilience. *Frontiers of Engineering Management*, 10(2), 360.
<https://doi.org/10.1007/s42524-023-0257-1>
12. Abuhlimeh, A., & Ali, O. (2023). Comprehensive review for healthcare data quality challenges in blockchain technology [Review of Comprehensive review for healthcare data quality challenges in blockchain technology]. *Frontiers in Big Data*, 6. *Frontiers Media*.
<https://doi.org/10.3389/fdata.2023.1173620>

13. Alsaleh, A. (2024). The impact of technological advancement on culture and society. *Scientific Reports*, 14(1). <https://doi.org/10.1038/s41598-024-83995-z>
14. Assadullah, M. M. (2019). Barriers to Artificial Intelligence Adoption in Healthcare Management: A Systematic Review [Review of Barriers to Artificial Intelligence Adoption in Healthcare Management: A Systematic Review]. *SSRN Electronic Journal*. RELX Group (Netherlands). <https://doi.org/10.2139/ssrn.3530598>
15. Chen, Y.-H. (2023). Integrating Explainable Artificial Intelligence and Blockchain to Smart Agriculture with Decision Making and Improved Security. <https://doi.org/10.2139/ssrn.4446597>
16. Chen, Y.-H., Sharma, K., Sharma, C., & Sharma, S. (2023). Integrating explainable artificial intelligence and blockchain to smart agriculture: Research prospects for decision making and improved security. *Smart Agricultural Technology*, 6, 100350. <https://doi.org/10.1016/j.atech.2023.100350>
17. Priya, P. K., & Anusha, K. (2019). Fintech Issues and Challenges in India. *International Journal of Recent Technology and Engineering (IJRTE)*, 8(3), 904. <https://doi.org/10.35940/ijrte.c4087.098319>
18. Ruël, H., & Njoku, E. (2020). AI redefining the hospitality industry. *Journal of Tourism Futures*, 7(1), 53. <https://doi.org/10.1108/jtf-03-2020-0032>
19. Chang, H., & Lund, B. (2025). Bringing AI and Blockchain Synergy into Cyber Threat Intelligence Cycle. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.5191276>
20. Liu, W., He, Y., Dong, J., & Cao, Y. (2023). Disruptive technologies for advancing supply chain resilience. *Frontiers of Engineering Management*, 10(2), 360. <https://doi.org/10.1007/s42524-023-0257-1>
21. Periyasamy, A., Deepankumar, E., Kokila, D., & Nanda Kumar, N. (2024). Blockchain Technology in Modern Agriculture: Exploring Techniques and Applications for Enhancing Transparency, Efficiency, and Traceability in Current Agricultural Systems.
22. Adel, N. (2024). The Impact of Digital Literacy and Technology Adoption on Financial Inclusion in Africa, Asia, and Latin America. *Heliyon*, 10(24). <https://doi.org/10.1016/j.heliyon.2024.e4095> 1
23. Chang, H., & Lund, B. (2025). Bringing AI and Blockchain Synergy into Cyber Threat Intelligence Cycle. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.5191276>
24. Mandru, S. kanth. (2022). How AI can improve identity verification and access