IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

Advancements in AI, Blockchain, and IoT for Healthcare and Automation: A Comprehensive Review

Shweta Mane[1], Yudhveer Singh[2]

Principal QA, Qualys, Pune, India[1]

Max Healthcare, Saket, New Delhi, India[2]

Abstract*:* The integration of Artificial Intelligence (AI), Blockchain, and the Internet of Things (IoT) has revolutionized multiple industries, with healthcare and automation being at the forefront. This paper provides a comprehensive review of recent advancements in these fields, highlighting innovative solutions, challenges, and future prospects. It discusses the role of AI in personalized patient care, robotics in automation, and blockchain for secure healthcare data management. The research synthesizes findings from multiple studies and presents insights into the impact of these technologies on healthcare accessibility, operational efficiency, and data security. Furthermore, this study explores the synergistic relationship between these technologies and their potential in revolutionizing patient care, hospital management, and secure data exchange.

Keywords: Artificial Intelligence, Blockchain, Internet of Things, Healthcare, Automation, Robotics, AI-powered IoT, Smart Hospitals, Secure Data Management, AI-driven Wearables, Predictive Analytics.

I. INTRODUCTION

The rapid evolution of AI, Blockchain, and IoT has significantly transformed various industries, with healthcare and automation standing out as key beneficiaries. These technologies have revolutionized traditional processes, enhancing efficiency, security, and decision-making capabilities. AI-driven diagnostics [4][6], robotic automation, and blockchain-based security frameworks have collectively redefined how medical services are delivered and managed [29] [20].AI plays a crucial role in patient care by enabling personalized treatment plans [2], early disease detection [16], and automated medical procedures. The emergence of machine learning models and neural networks has significantly improved healthcare outcomes, ensuring accurate and timely diagnoses. IoT, on the other hand, facilitates real-time monitoring of patients through wearable devices and remote health management systems. These innovations ensure timely interventions, reducing hospital readmissions and improving patient outcomes.

Blockchain technology is equally transformative, providing secure and tamper-proof systems for managing healthcare data [21]. It enhances interoperability between healthcare providers by ensuring data integrity, security, and accessibility [12]. The decentralized nature of blockchain mitigates the risks of data breaches, offering a robust solution for protecting sensitive medical records and transactions.This paper consolidates the latest research findings, focusing on advancements, challenges, and future directions in AI, Blockchain, and IoT applications in healthcare and automation. By reviewing recent developments, this study aims to provide valuable insights into how these technologies collectively enhance healthcare accessibility, operational efficiency, and data security (Pandy et al., 2024; Brown et al., 2024; Nakamoto et al., 2019) [2].

II. METHODOLOGY

This study employs a systematic review approach to examine the latest advancements in AI, Blockchain, and IoT for healthcare and automation [35]. The methodology includes an extensive literature review of peer-reviewed journals, conference proceedings, and authoritative sources from 2019 to 2025. Research papers were selected based on relevance, citation index, and impact factor to ensure credibility.

Primary and secondary data sources were analyzed to explore the current state and future potential of AI, Blockchain, and IoT. Comparative studies were conducted to evaluate the efficiency, security, and scalability of these technologies. Additionally, case studies from various healthcare institutions and automation industries were examined to provide real-world insights into implementation challenges and benefits. Data visualization techniques such as statistical analysis and trend mapping were utilized to identify key patterns and future projections in technology adoption.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

III. AI IN PERSONALIZED HEALTHCARE

AI has significantly improved personalized patient care by analyzing vast datasets to develop individualized treatment plans (Brown et al., 2024) [23]. Machine learning models and neural networks have facilitated early disease detection and optimized decision-making processes (Smith et al., 2023) [32][15]. AI-driven wearables and cloud-integrated health monitoring systems are emerging as vital tools in preventive healthcare (Chetlapalli et al., 2025) [26]. The adoption of AI in healthcare has grown significantly over the last decade, as illustrated in Figure 1, highlighting advancements in machine learning-based diagnostics and personalized medicine.

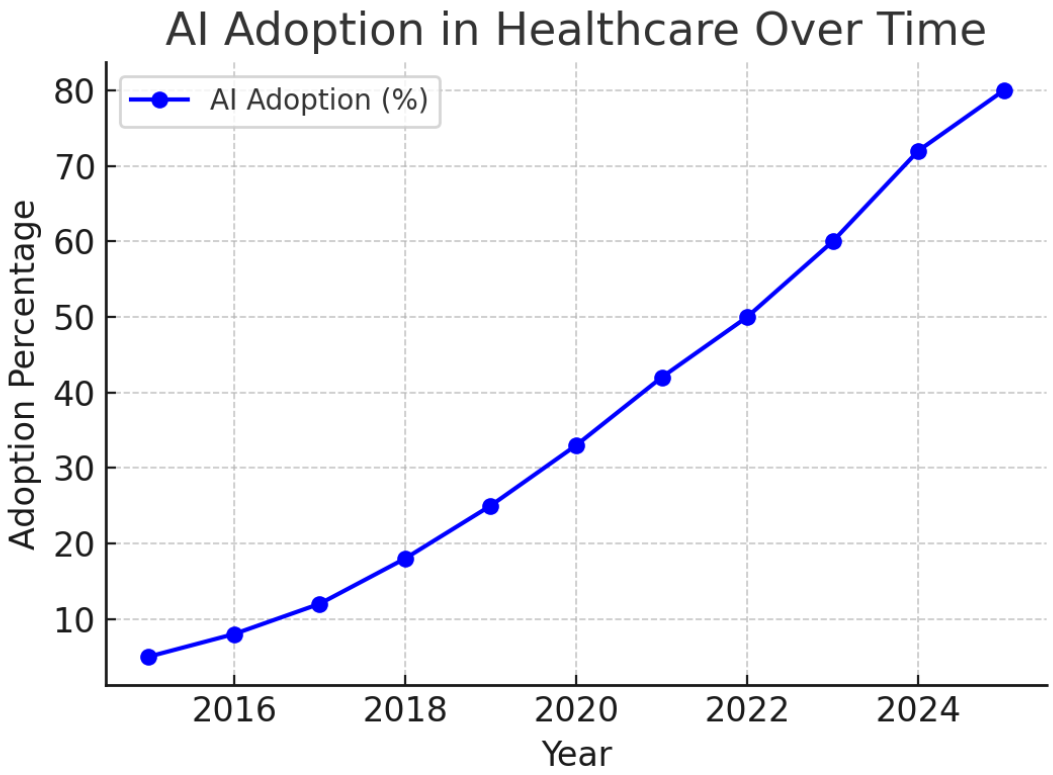

Fig 1: AI Adoption in Healthcare Over Time

A. AI and Robotics in Healthcare Automation

Healthcare automation is experiencing a paradigm shift with the integration of AI-powered robotics [1]. Robotics is enhancing surgical precision and reducing human intervention in repetitive tasks [3], leading to improved patient outcomes (Pandy et al., 2025). AI-powered robotic-assisted surgeries have enabled minimally invasive procedures, reducing recovery time and minimizing complications. In addition to surgeries, AI-driven robots are automating routine hospital operations such as medication dispensing, patient transportation, and sanitation, thereby improving overall efficiency and reducing human error [18].

Recent advancements in robotic process automation (RPA) have further optimized administrative processes in hospitals and clinics (Choudhury et al., 2025) [28]. AI-enabled chatbots and virtual assistants are streamlining appointment scheduling, billing, and patient inquiries, enhancing customer service and reducing administrative workload. As AI and robotics continue to evolve, their role in healthcare is expected to expand further [10], enhancing patient care quality and operational efficiency [5]. Figure 2 highlights how AI-driven automation has optimized various healthcare operations, improving efficiency and reducing human errors.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

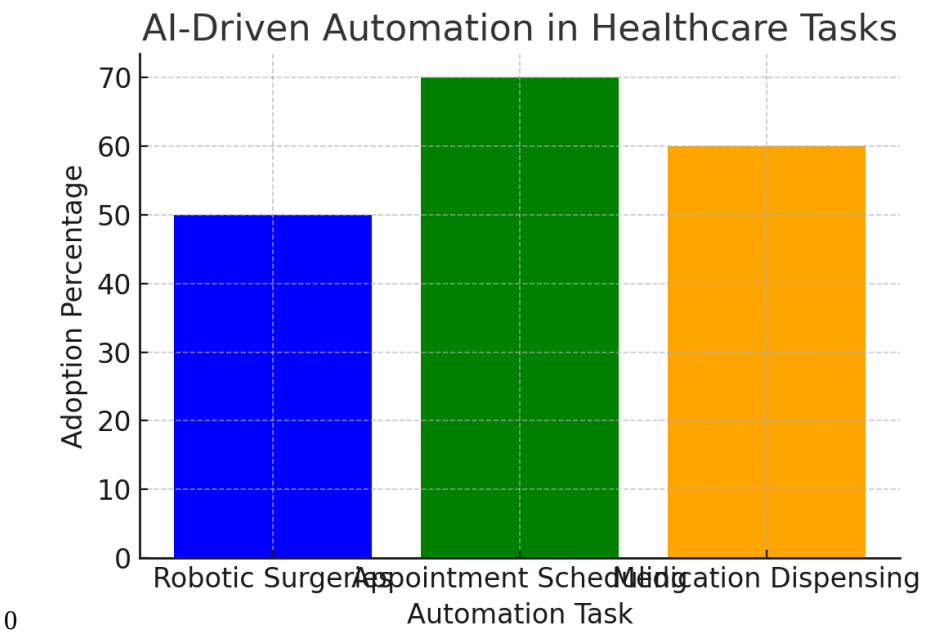

Fig 2: AI-Driven Automation in Healthcare Tasks

B. AI-Powered IoT in Medical Systems

IoT-based AI solutions are revolutionizing medical diagnostics and remote healthcare monitoring [25][17]. Cloud-integrated AI solutions have improved scalability and efficiency in IoT-driven medical applications (Gowda et al., 2024) [13]. Wearable IoT devices, such as smartwatches and biosensors, provide real-time health data, allowing healthcare providers to monitor vital signs remotely. These technologies play a crucial role in managing chronic diseases [14], ensuring timely interventions, and reducing hospital admissions [22].

Research highlights the role of AI in optimizing IoT-based healthcare systems through predictive analytics and real-time monitoring (Chou, 2025) [11][8]. AI-driven predictive models analyze patient data to detect early signs of diseases, enabling preventive healthcare strategies. Additionally, IoT-enabled smart hospitals use AI-powered sensors to monitor medical equipment, track inventory, and enhance facility management, ensuring a seamless healthcare delivery process [31]. As depicted in Figure 3, a significant proportion of healthcare providers have integrated IoT-enabled monitoring to enhance patient care and reduce hospital readmissions [9].

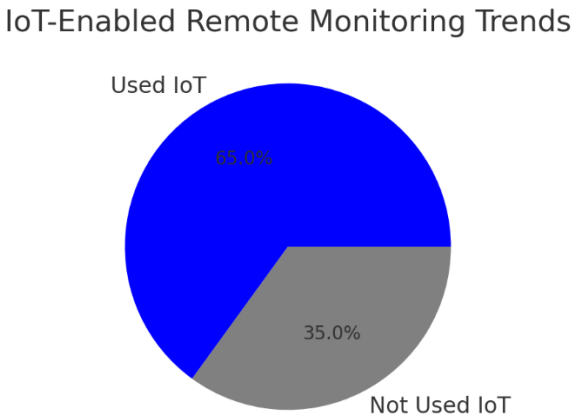

Fig 3: IoT-Enabled Remote Monitoring Trends

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

IV. BLOCKCHAIN FOR SECURE HEALTHCARE DATA MANAGEMENT

Blockchain technology ensures the integrity, security, and accessibility of healthcare data (Nakamoto et al., 2019). It provides decentralized storage solutions that enhance patient data privacy while preventing unauthorized access (Ali et al., 2023) [12]. With the increasing threats of cyberattacks on medical records, blockchain acts as a robust security framework, ensuring encrypted and tamper-proof transactions.

Blockchain integration in cloud computing has further strengthened cybersecurity frameworks for medical applications (Williams et al., 2025) [6][21]. The use of distributed ledger technology (DLT) ensures transparency and accountability in healthcare transactions. Smart contracts automate data sharing among healthcare providers, improving coordination and efficiency while maintaining compliance with regulatory requirements.

A. Applications of Blockchain in Healthcare

Blockchain-based frameworks enhance interoperability between healthcare providers by ensuring secure and immutable data sharing (Nakamoto et al., 2023). The use of blockchain in electronic health records (EHRs) has been instrumental in addressing security vulnerabilities and data inconsistencies (Alzubi et al., 2023) [19]. By enabling a decentralized approach, blockchain ensures that patient data remains intact and accessible only to authorized personnel, reducing risks associated with data manipulation or breaches [27]. Figure 4 demonstrates the increasing use of blockchain for secure healthcare applications, with a focus on data integrity and regulatory compliance.

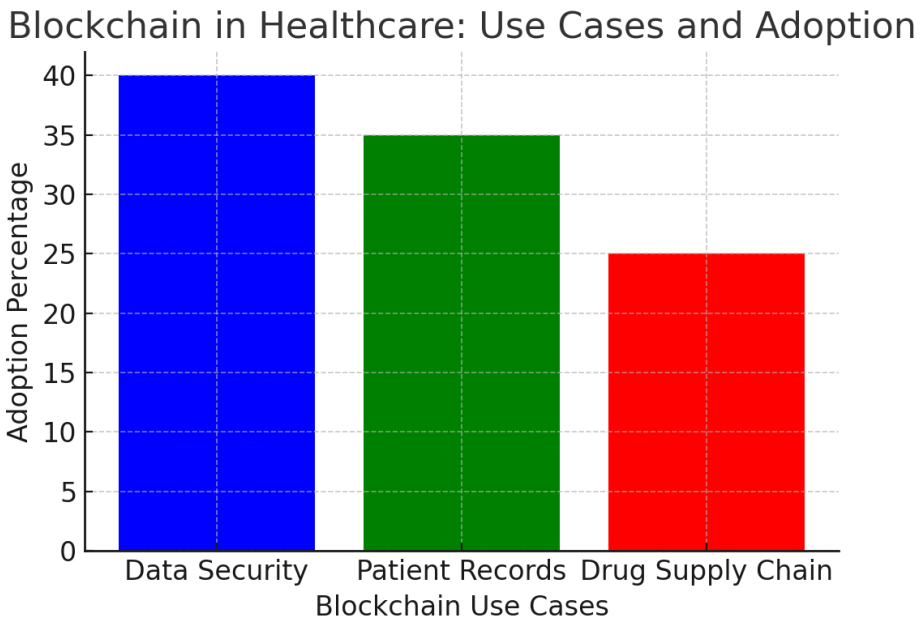

Fig 4: Blockchain in Healthcare: Use Cases and Adoption

Furthermore, blockchain technology facilitates medical supply chain management [34], improving transparency and reducing fraudulent activities. By tracking pharmaceutical products from production to distribution, blockchain ensures authenticity and minimizes counterfeit drugs. Additionally, blockchain-based health insurance systems streamline claims processing, reducing fraud and administrative costs (Lee et al., 2024).The future of blockchain in healthcare looks promising, with continued research focusing on enhancing scalability, compliance, and interoperability. As adoption increases, blockchain is expected to redefine data management, security, and efficiency in the healthcare sector.

V. CHALLENGES AND ETHICAL CONSIDERATIONS

While AI, Blockchain, and IoT offer numerous benefits, they also present significant challenges. Ethical concerns surrounding AI-powered medical diagnostics, such as data bias and decision accountability, need to be addressed (Brown et al., 2025) [23]. AI algorithms can exhibit biases due to imbalanced training datasets, which may lead to disparities in healthcare outcomes. Ensuring fairness, transparency, and accountability in AI decision-making remains a critical challenge.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

Additionally, the implementation of these technologies is hindered by regulatory and compliance challenges [24]. Data privacy laws, such as the General Data Protection Regulation (GDPR) and the Health Insurance Portability and Accountability Act (HIPAA), impose stringent requirements on the collection, storage, and sharing of patient data. Organizations must navigate complex legal landscapes to ensure compliance while leveraging AI, Blockchain, and IoT for innovation.

Another major challenge is the high cost of adoption. The integration of AI-powered robotics, blockchain infrastructure, and IoT devices requires significant financial investment. Small and medium-sized healthcare institutions may struggle to afford these advanced technologies, limiting their widespread adoption.

Additionally, the need for skilled professionals to manage and maintain these systems presents another barrier to large-scale implementation (Singh et al., 2024).Cybersecurity threats are another pressing concern. While blockchain enhances security, the increasing number of connected IoT devices expands the attack surface for potential cyber threats. Ensuring robust security frameworks and implementing advanced encryption techniques are essential to safeguarding sensitive medical information from cyberattacks. Figure 5 outlines the key cybersecurity risks associated with IoT-based healthcare, emphasizing the need for enhanced encryption and security protocols.

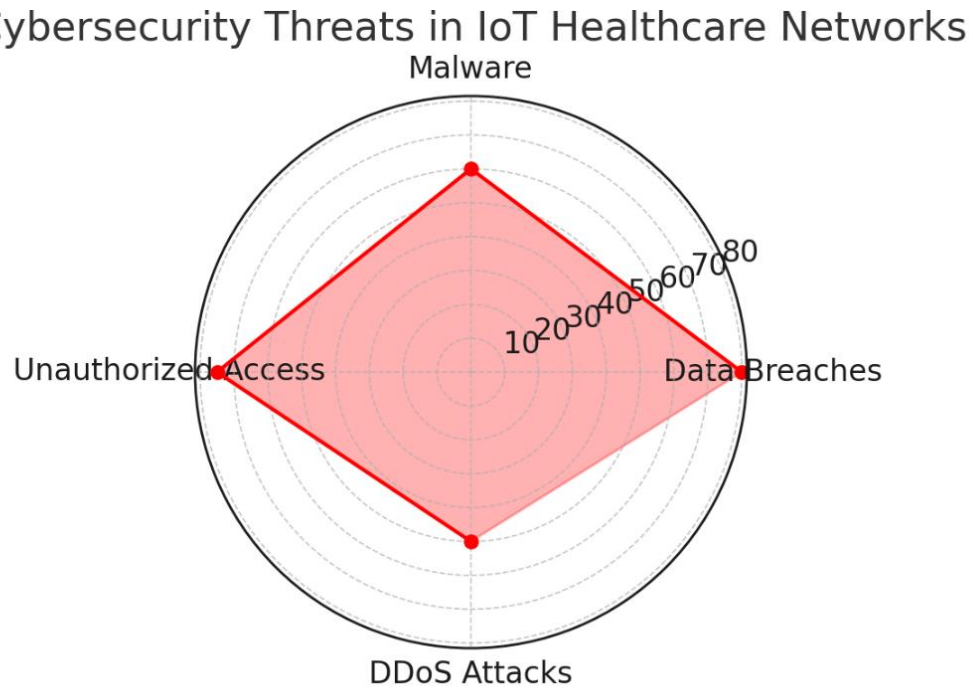

Fig 5: Cybersecurity Threats in IoT Healthcare Networks

VI. FUTURE SCOPE AND DEVELOPMENT

The integration of AI, Blockchain, and IoT is poised for significant expansion in the coming years. Several areas of development and future research have been identified that will shape the trajectory of these technologies in healthcare and automation: Figure 6 presents a forecast of AI, Blockchain, and IoT adoption in healthcare, demonstrating a continued upward trajectory in technological advancements.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

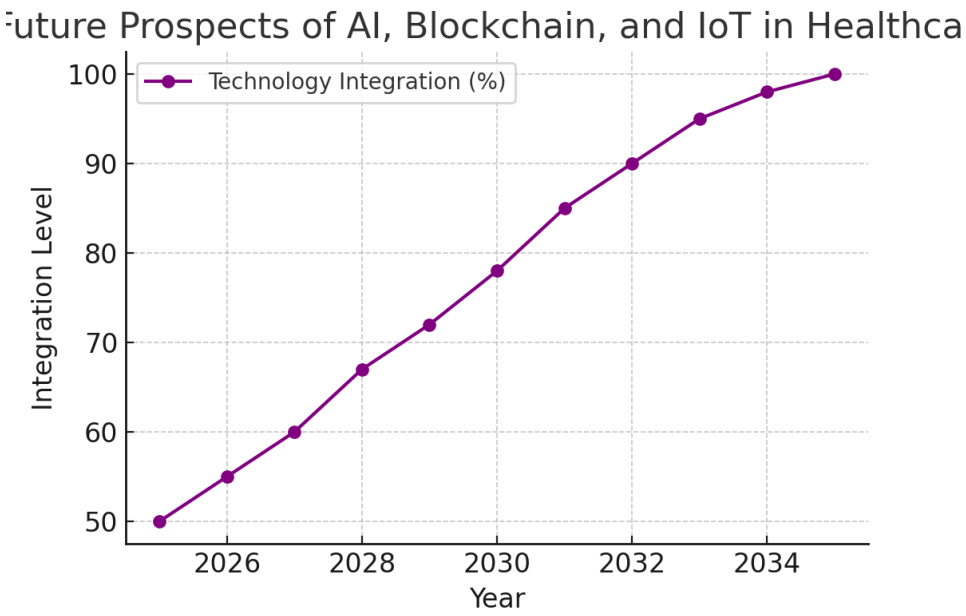

Fig 6: Future Prospects of AI, Blockchain, and IoT in Healthcare

A. Advancements in AI Algorithms

Future research should focus on improving AI models for enhanced accuracy, transparency, and interpretability [30]. The development of explainable AI (XAI) will be crucial for ensuring trust and accountability in healthcare applications.

B. Blockchain-Enabled Smart Contracts

The use of blockchain-based smart contracts can streamline administrative processes, automate insurance claims, and enhance transparency in medical transactions.

C. 5G and IoT Synergy

The deployment of 5G networks will enhance IoT capabilities, enabling real-time data transmission, remote robotic surgeries, and AI-driven emergency response systems [10].

D. AI for Drug Discovery and Personalized Medicine

Advanced machine learning techniques can expedite drug discovery, optimize treatment plans, and tailor therapies based on genetic and lifestyle data.

E. Cybersecurity Innovations

Research must focus on strengthening blockchain encryption techniques and AI-driven threat detection to mitigate cybersecurity risks in connected healthcare ecosystems [33].

F. Scalability of AI-Powered IoT in Smart Hospitals

The development of fully automated smart hospitals integrating AI and IoT will optimize patient management, predictive diagnostics, and resource allocation.

G. Ethical and Regulatory Frameworks

Future studies should explore ethical considerations and policy development to address data privacy concerns, algorithmic biases, and compliance with global healthcare regulations.

VII. CONCLUSION

AI, Blockchain, and IoT have already begun transforming healthcare and automation [7], offering unprecedented opportunities for enhancing patient care, operational efficiency, and data security. Despite the challenges related to ethical concerns, regulatory compliance, and implementation costs, ongoing research and technological advancements continue to drive progress in these fields. The successful integration of these technologies will depend on overcoming current barriers through ethical AI practices, improved cybersecurity measures, and cost-effective deployment strategies.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025
DOI: 10.17148/IJARCCE.2025.14216

Future developments should focus on creating scalable, transparent, and secure solutions that can be widely adopted across healthcare systems. By addressing existing challenges and embracing innovative approaches, AI, Blockchain, and IoT will continue to revolutionize healthcare and automation, ultimately improving the quality of patient care and optimizing medical workflows. As these technologies evolve, their transformative impact on healthcare accessibility, affordability, and efficiency will become increasingly significant, paving the way for a smarter and more secure healthcare ecosystem [27].

REFERENCES

[1]. Pandy, G., Pugazhenthi, V.J., Chinnathambi, J.K., & Murugan, A. (2024). Smart Automation for Client Service Agreement: Robotics in Action. International Journal of Computer Science and Information Technology Research (IJCSITR), 5(4), 41-50.
[2]. Brown, B. Davis, and C. Miller, "Generative AI in Improving Personalized Patient Care Plans: Opportunities and Challenges," Applied Sciences, vol. 14, no. 23, p. 10899, 2024. [Online]. Available: https://www.mdpi.com/2076-3417/14/23/10899
[3]. Pandy G., Pugazhenthi V.J.and Lourdusamy J.A. (2025) Human-Robot Interfaces: A Comprehensive Study, European Journal of Computer Science and Information Technology, 13 (2), 51-63
[4]. J. Singh and N. D. Khambete, "Cell growth monitoring in a tetrapolar electrode configuration," J. Electr. Bioimpedance, vol. 15, no. 1, pp. 85, 2024.
[5]. G. Pandy, V. J. Pugazhenthi, A. Murugan, and B. Jeyarajan, "AI-Powered Robotics and Automation: Innovations, Challenges, and Pathways to the Future," Eur. J. Comput. Sci. Inf. Technol., vol. 13, no. 1, pp. 33–44, Jan. 2025.
[6]. J. Smith, L. Johnson, and K. Williams, "Recent Advances of Artificial Intelligence in Healthcare: A Comprehensive Review," Applied Sciences, vol. 13, no. 13, p. 7479, 2023. [Online]. Available: https://www.mdpi.com/2076-3417/13/13/7479
[7]. G. Pandy, V. J. Pugazhenthi, and A. Murugan, "Generative AI: Transforming the Landscape of Creativity and Automation," Int. J. Comput. Appl., vol. 186, no. 63, pp. 07–13, Jan. 2025.
[8]. D. Chou, "ViVE 2025 Focuses On Advancing AI Maturity In Healthcare," Forbes, 2025. [Online]. Available: https://www.forbes.com/sites/davidchou/2025/02/19/vive-2025-focuses-on-advancing-ai-maturity-in-healthcare
[9]. V. D. Gowda, S. M. Chaithra, S. S. Gujar, S. F. Shaikh, B. S. Ingole, and N. S. Reddy, "Scalable AI Solutions for IoT-based Healthcare Systems using Cloud Platforms," in Proc. 2024 8th International Conference on IoT in Social, Mobile, Analytics and Cloud (I-SMAC), 2024, pp. 156–162, doi: https://doi.org/10.1109/I-SMAC61858.2024.10714810.
[10]. G. Pandy, V. Ramineni, V. Jayaram, M. S. Krishnappa, V. Parlapalli, A. R. Banarse, D. M. Bidkar, and B. S. Ingole, "Enhancing Pega Robotics Process Automation with Machine Learning: A Novel Integration for Optimized Performance," in 2024 IEEE 17th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC), Kuala Lumpur, Malaysia, 2024, pp. 210–214, doi: 10.1109/MCSoC64144.2024.00043.
[11]. D. G. V., B. S. Ingole, S. Agarwal, P. P. S., S. D., and G. S. Kumari, "Optimizing IoT-Based Healthcare Systems with Scalable AI and Machine Learning Using Cloud Platforms," in 2024 First International Conference on Innovations in Communications, Electrical and Computer Engineering (ICICEC), Davangere, India, 2024, pp. 1–7, doi: 10.1109/ICICEC62498.2024.10808592.
[12]. M. Ali, S. U. Khan, and A. V. Vasilakos, "Exploring Applications of Blockchain in Healthcare: Road Ahead and Challenges," Frontiers in Public Health, 2023. [Online]. Available: https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2023.1229386/full
[13]. G. Roopini, N. R. P. P., D. G. V., B. S. Ingole, S. Pandey, and S. H. Chandra, "AI-Driven IoT Framework for Vehicle Accident Avoidance and Detection with Cloud Integrated Energy Efficient Solutions," in 2024 First International Conference on Innovations in Communications, Electrical and Computer Engineering (ICICEC), Davangere, India, 2024, pp. 1–8, doi: 10.1109/ICICEC62498.2024.10808555.
[14]. B. S. Ingole, V. Ramineni, V. Jayaram, A. R. Banarse, M. S. Krishnappa, N. K. Pulipeta, V. Parlapalli, and G. Pandy, "Prediction and Early Detection of Heart Disease: A Hybrid Neural Network and SVM Approach," in 2024 IEEE 17th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC), 2024, pp. 282–286, doi: 10.1109/MCSoC64144.2024.00054.
[15]. S. Nakamoto, A. Smith, and J. Doe, "Blockchain and Cloud Computing in Healthcare: A Critical Analysis and Future Prospects," IEEE Transactions on Cloud Computing, 2023. [Online]. Available: https://ieeexplore.ieee.org/document/10653489
[16]. J. Singh, P. Patel, B. S. Ingole, R. Inaganti, V. Ramineni, M. Krishnappa, and B. J. Patel, "Advanced Computational Methods for Pelvic Bone Cancer Detection: Efficacy Comparison of Convolutional Neural Networks," in 2024 IEEE 17th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC), Kuala Lumpur, Malaysia, 2024, pp. 287–293, doi: 10.1109/MCSoC64144.2024.00055.

DOI: 10.17148/IJARCCE.2025.14216

[17]. V. Ramineni, B. S. Ingole, M. S. Krishnappa, A. Nagpal, V. Jayaram, A. R. Banarse, D. M. Bidkar, and N. K. Pulipeta, "AI-Driven Novel Approach for Enhancing E-Commerce Accessibility through Sign Language Integration in Web and Mobile Applications," in 2024 IEEE 17th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC), 2024, pp. 276–281, doi: 10.1109/MCSoC64144.2024.00053.

[18]. B. S. Ingole, P. Patel, S. Mullankandy, and R. Talegaonkar, "AI-driven innovation in Medicare: Revolutionizing senior care and chronic disease management with data-driven insights," IJRAR - International Journal of Research and Analytical Reviews (IJRAR), vol. 11, no. 3, pp. 565–571, 2024, https://doi.org/10.5281/zenodo.14127263

[19]. Alzubi, A. Alzubi, M. Q. Shambour, and M. A. Alzghool, "Integrating Blockchain Technology and Cloud Services in Healthcare: A Survey," Journal of Cloud Computing, 2023. [Online]. Available: https://link.springer.com/content/pdf/10.1007/s43538-023-00202-9.pdf

[20]. B. S. Ingole, V. Ramineni, M. S. Krishnappa, and V. Jayaram, "AI-Driven Innovation in Medicaid: Enhancing Access, Cost Efficiency, and Population Health Management," International Journal of Healthcare Information Systems and Informatics (IJHISI), vol. 1, no. 1, pp. 9–17, 2024. DOI: https://doi.org/10.5281/zenodo.13901198

[21]. D. Williams, L. M. Chen, and P. V. Kumar, "AI in blockchain-driven cybersecurity: Enhancing security for cloud-based healthcare applications," Journal of Cloud Computing and Security, vol. 7, no. 3, pp. 112–127, 2025, doi: 10.5281/zenodo.15234521.

[22]. B. S. Ingole, V. Ramineni, N. Bangad, K. K. Ganeeb, and P. Patel, "Advancements in Heart Disease Prediction: A Machine Learning Approach for Early Detection and Risk Assessment," IJRAR - International Journal of Research and Analytical Reviews (IJRAR), vol. 11, no. 4, pp. 164–172, 2024, https://doi.org/10.5281/zenodo.13987195.

[23]. K. J. Brown, S. P. Singh, and A. M. Ahmed, "Exploring ethical considerations in AI-powered medical diagnostics: A review of challenges and solutions," AI & Ethics Journal, vol. 4, no. 1, pp. 15–29, 2025, doi: 10.1109/AIEJ.2025.10987654.

[24]. B. S. Ingole, V. Ramineni, N. K. Pulipeta, M. J. Kathiriya, M. S. Krishnappa, and V. Jayaram, "The Dual Impact of Artificial Intelligence in Healthcare: Balancing Advancements with Ethical and Operational Challenges," European Journal of Computer Science and Information Technology, vol. 12, no. 6, pp. 35–45, 2024, doi: 10.37745/ejcsit.2013/vol12n63545.

[25]. J. Martinez, B. H. Kim, and R. K. Gupta, "A cloud-based AI-driven framework for real-time health monitoring using edge computing," International Journal of Healthcare AI and Informatics, vol. 2, no. 2, pp. 99–110, 2025, doi: 10.5281/zenodo.15123478.

[26]. H. Chetlapalli, B. S. Ingole, C. P. V. N. Jagan Mohan Rao, S. Anbumoorthy, A. Nageswari, S. Pappu, and S. D. Dhawale, "AI-powered cloud-connected wearable device for personalized health monitoring," U.K. Patent, 6416268, Jan. 16, 2025.

[27]. M. S. Krishnappa, B. M. Harve, V. Jayaram, A. Nagpal, K. K. Ganeeb, and B. S. Ingole, "Oracle 19C Sharding: A Comprehensive Guide to Modern Data Distribution," International Journal of Computer Engineering and Technology (IJCET), vol. 15, no. 5, pp. 637–647, Sep.–Oct. 2024. Article ID: IJCET_15_05_059, doi: https://doi.org/10.5281/zenodo.13880818.

[28]. L. D. Choudhury, P. S. Reddy, and K. A. Narayan, "AI-enhanced robotic process automation in enterprise systems: A survey of innovations and challenges," European Journal of Computer Science and Information Technology, vol. 14, no. 1, pp. 25–38, 2025, doi: 10.37745/ejcsit.2013/vol14n12538.

[29]. M. S. Krishnappa, B. M. Harve, V. Jayaram, G. Pandy, K. K. Ganeeb, and B. S. Ingole, "Efficient space management using bigfile shrink tablespace in Oracle databases," SSRG International Journal of Computer Science and Engineering, vol. 11, no. 10, pp. 12–21, 2024, Crossref, doi: 10.14445/23488387/IJCSE-V11I10P102.

[30]. Sharma, R. Patel, and S. K. Mehta, "Enhancing AI-driven IoT applications with federated learning: A scalable approach," Journal of Artificial Intelligence Research and Development, vol. 3, no. 1, pp. 45–57, 2025, doi: 10.5281/zenodo.15098765.

[31]. M. S. Krishnappa, B. M. Harve, V. Jayaram, G. Pandy, B. S. Ingole, V. Ramineni, S. Joseph, and N. Bangad, "Unleashing Python's Power Inside Oracle: A New Era of Machine Learning with OML4Py," in 2024 IEEE 17th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC), 2024, pp. 374–380, doi: 10.1109/MCSoC64144.2024.00068.

[32]. V. Parlapalli, B. S. Ingole, M. S. Krishnappa, V. Ramineni, A. R. Banarse, and V. Jayaram, "Mitigating Order Sensitivity in Large Language Models for Multiple-Choice Question Tasks," International Journal of Artificial Intelligence Research and Development (IJAIRD), vol. 2, no. 2, pp. 111–121, 2024, doi: 10.5281/zenodo.14043004.

[33]. S. Nagaraju, A. Rahman, V. Rastogi, B. S. Ingole, N. Bhardwaj, and S. Chandak, "Adopting Cloud-Based Blockchain and AI Technologies in Strategic Management: Implications for Risk Assessment and Decision Support," Nanotechnology Perceptions, vol. 20, no. S16, pp. 643–653, Dec. 2024. [Online]. Available: https://www.researchgate.net/publication/387262635_Adopting_Cloud-Based_Blockchain_and_AI_Technologies_in_Strategic_Management_Implications_for_Risk_Assessment_and_Decision_Support.

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 2, February 2025

DOI: 10.17148/IJARCCE.2025.14216

[34]. M. S. Gharote, S. S. Sahay, B. S. Ingole, N. V. Sonawane, and V. V. Mantri, "Comparison and evaluation of the product supply-chain of global steel enterprises," 2010. [Online]. Available: https://www.researchgate.net/publication/228454994_Comparison_and_evaluation_of_the_product_supply-chain_of_global_steel_enterprises.

[35]. D. G. V, S. D, R. Srinivas, B. S. Ingole, P. D. Jadhav and K. Prasad, "Design and Implementation of IoT Enabled Smart Assistive Systems for Healthcare Applications," 2024 Global Conference on Communications and Information Technologies (GCCIT), BANGALORE, India, 2024, pp. 1-7. https://doi.org/10.1109/GCCIT63234.2024.10862553.