JOURNAL OF ARTIFICIAL INTELLIGENCE AND ROBOTICS
Jan-Mar 2024, VOL. 1, ISSUE 1, pp. 1-3
https://doi.org/10.61577/jaiar.2024.100001

RESEAPRO JOURNALS

EDITORIAL

OPEN ACCESS

AIoT: bridging the gap between artificial intelligence and the internet of things

Hasyiya Karimah Adli[1,2], Nor Alina Ismail[1,2], Hadhrami Ab Ghani[1,2], Nurzulaikha Abdullah[1,2] and Fakhitah Ridzuan[1,2]

[1]Faculty of Data Science and Computing, Universiti Malaysia Kelantan, City Campus, Kelantan, Malaysia
[2]Institute for Artificial Intelligence and Big Data, Universiti Malaysia Kelantan, City Campus, Kelantan, Malaysia

ABSTRACT

An overview of the advancements and challenges in the artificial intelligence of things (AIoT) fields, focusing on various applications in agriculture, pandemic prevention, algae farming, livestock surveillance, and the smart supply chain, was summarized. It highlights the potential of AIoT to revolutionize industries and improve efficiency while emphasizing the need to address security, privacy, and ethical considerations. To push the development of AIoT, a few strategies, such as interdisciplinary collaboration, research funding, data sharing, and industry-academia collaboration, were suggested. By tackling these open research directions, AIoT can unlock its full potential and make a transformative impact on society.

KEYWORDS

Artificial intelligence; Internet of things; Artificial intelligence of things

ARTICLE HISTORY

Received 30 July 2023; Revised 29 September 2023; Accepted 6 October 2023

Introduction

Artificial intelligence of things (AIoT), the convergence of artificial intelligence (AI) and internet of things (IoT), is a revolutionary technological paradigm that transforms human interactions with technology. It combines IoT's sensing and data-gathering capabilities with AI algorithms' intelligence, enhancing their capabilities and opening up opportunities across various industries. AIoT aims to bridge the gap between the physical and digital worlds by imbuing IoT devices with AI-driven intelligence, enabling local processing and real-time decision-making. AIoT advancements include 5G network deployment, enhancing connectivity for real-time insights in applications like autonomous vehicles, smart city infrastructure, and remote healthcare monitoring. Meanwhile, edge computing is a distributed computing model that can reduce centralized cloud burden and privacy concerns, enabling faster response times, better scalability, and improved system performance. Besides, AIoT integrates advanced algorithms like deep learning and reinforcement learning, enabling IoT devices to learn from data, recognize patterns, and make informed decisions. This technology finds applications in various industries, including manufacturing, healthcare, and smart factories, improving patient outcomes and reducing costs.

Selection of Papers

Adli et al. discussed the potential of AIoT in transforming agriculture by combining AI technologies with IoT devices [1]. It covers areas like precision farming, crop monitoring, soil quality assessment, and automated irrigation systems. AIoT-driven solutions provide real-time data insights, enabling farmers to make informed decisions and optimize resource utilization. A few challenges faced in implementing AIoT were also discussed in terms of data security, interoperability, affordability, and accessibility in rural areas. The review also analyzes potential future directions and research opportunities in AIoT for smart agriculture, proposing novel approaches, innovative technologies, and interdisciplinary collaborations. By addressing these challenges and embracing new research directions, AIoT can play a crucial role in shaping the future of smart agriculture, benefiting farmers and the global food supply chain.

Chen et al. reviewed the application of AIoT in the pandemic [2]. The authors emphasize the benefits of AIoT in improving accuracy and efficiency, tracking individuals, identifying hotspots, and enforcing preventive measures. Applications such as AI-powered medical imaging, contact tracing, social distancing monitoring, and AI-driven data analytics were highlighted. However, challenges like privacy concerns, data security, and reliable data sources remain. The review also highlights the potential implications of AIoT in shaping future preparedness and response strategies.

Liao et al. introduced a cost-effective, wireless, and multi-channel AIoT system for monitoring algae cultures in algae farms [3]. The system integrates IoT devices and AI algorithms, collecting real-time data from multiple channels. The AIoT system uses algorithms for data analysis and decision-making, enhancing algae cultivation conditions and providing actionable insights for farm management. The wireless nature of the system allows remote monitoring and control, enhancing flexibility and scalability. The integration of AIoT technologies leads to improved efficiency and reduced operational costs for farmers, contributing to green technologies and industries.

Su et al. proposed a novel smart livestock surveillance system that combines AIoT devices and cloud computing to provide semantic information using deep networks [4]. The system aims to offer efficient surveillance despite the limited

***Correspondence:** Dr. Hasyiya Karimah Adli, Associate Professor, Faculty of Data Science and Computing, Universiti Malaysia Kelantan, City Campus, Kelantan, Malaysia, e-mail: hasyiya@umk.edu.my

resources of AIoT devices. Two key designs were presented: deep-net assembling as a semantic surveillance service and the expandable-convolutional-block neural network (ECB-Net). The former follows a divide-and-conquer approach, enabling the creation of semantic surveillance systems for livestock industries. The latter is a neural network designed to filter insignificant camera images, ensuring the system's robustness. The article details the architecture design and optimal ECB-Net model creation. A prototype of the smart livestock surveillance system is developed and tested in real-world swine rooms. The testing results demonstrate the superior performance of the proposed system in livestock surveillance.

An analysis of the challenges of AIoT for the smart supply chain was reported recently [5]. The authors discuss the challenges and opportunities of AIoT implementation in the fast-moving consumer goods (FMCG) industries. The authors highlight the transformative potential of AIoT in enabling real-time data analysis, predictive modeling, and autonomous decision-making. The case study focuses on optimizing inventory management, demand forecasting, distribution, and logistics, leading to improved efficiency and reduced operational costs. The authors also discuss data security, privacy concerns, interoperability, scalability, and standardization in AIoT implementation. The article also highlights the importance of robust AI models and advanced analytics in extracting valuable insights from supply chain data. By addressing these challenges, businesses in the FMCG sector can unlock the full potential of AIoT, gaining a competitive edge and enhancing customer satisfaction.

Open Research Directions

The development of the AIoT field requires collaboration from researchers, practitioners, policymakers, and industry players to advance its growth. Strategies include interdisciplinary collaboration, research funding, data sharing, standardization, and industry-academia collaboration can be considered [6,7]. These efforts aim to create a secure, privacy-preserving environment for AIoT development, enabling the deployment of impactful solutions that address real-world challenges and improve various industries and societal domains. Hence, the AIoT field can be accelerated, leading to the deployment of transformative AIoT solutions that address real-world challenges and improve various industries and societal domains. Researchers and practitioners may unleash the full potential of AIoT and define its future impact on society by tackling these open research directions.

Security and privacy

As the number of connected devices increases, ensuring the security and privacy of AIoT systems becomes paramount [8]. Research on robust authentication mechanisms, secure data transmission, and data privacy protection is crucial to safeguarding sensitive information and preventing potential cyberattacks.

Energy efficiency

AIoT systems often rely on resource-constrained devices with limited battery life. Investigating energy-efficient AI algorithms and optimized data processing at the edge can help minimize energy consumption [9], prolong device lifespans, and enhance the sustainability of AIoT deployments.

Ethical considerations

As AIoT becomes more pervasive, addressing its ethical implications becomes essential. Research on establishing ethical frameworks for AIoT, addressing bias in AI algorithms, and ensuring transparency and accountability in decision-making is vital to building trust and fostering responsible AIoT practices.

Interoperability

The diversity of IoT devices and AI platforms presents challenges in achieving seamless communication and data exchange [10]. Exploring standardized protocols and middleware solutions to enable interoperability can enhance the scalability and compatibility of AIoT ecosystems.

Novel AIoT applications

Continued research on novel AIoT applications in various sectors, such as agriculture, healthcare, smart cities, and industrial automation, can unlock untapped potential for transformative solutions. Investigating use cases, real-world implementations, and their impact on society will drive innovation and broaden AIoT's reach.

Edge AI and federated learning

Advancing research on edge AI and federated learning can empower AIoT devices with local data processing capabilities while preserving data privacy. These approaches can lead to improved response times, reduced bandwidth requirements, and enhanced data security.

Explainable AI for AIoT

The interpretability of AI models becomes crucial in critical domains like healthcare and autonomous systems. Research on developing explainable AI techniques for AIoT can enhance the trustworthiness of AI decisions and enable human understanding of complex AI-driven processes.

Resilience and robustness

For AIoT applications to remain reliable and uninterrupted in dynamic situations, it is important to explore ways to improve the resilience and robustness of AIoT systems against adversarial assaults, anomalous data, and technological failures.

Conclusions

AIoT stands at the forefront of technological innovation, offering boundless possibilities for creating a smarter, more connected world. By combining the intelligence of AI with the ubiquity of IoT devices, AIoT has the potential to revolutionize industries, improve efficiency, and enhance the quality of life for individuals worldwide. However, realizing the full potential of AIoT requires addressing security challenges, promoting interoperability, and upholding ethical principles. Through collaborative efforts from researchers, policymakers, and industry stakeholders, AIoT can bridge the gap between the physical and digital realms, ushering in a new era of intelligent, data-driven innovation.

Disclosure statement

No potential conflict of interest was reported by the authors.

https://doi.org/10.61577/jaiar.2024.100001

References

1. Adli HK, Remli MA, Wan Salihin Wong KN, Ismail NA, González-Briones A, Corchado JM, et al. Recent advancements and challenges of AIoT application in smart agriculture: a review. Sensors. 2023;23(7):3752. https://doi.org/10.3390/s23073752
2. Chen SW, Gu XW, Wang JJ, Zhu HS. AIoT used for COVID-19 pandemic prevention and control. Contrast Media Mol. Imaging. 2021;2021:1-23. https://doi.org/10.1155/2021/3257035
3. Liao Y, Yu N, Zhou G, Wu Y, Wang CA. wireless multi-channel low-cost lab-on-chip algae culture monitor AIoT system for algae farm. Comput Electron Agric. 2022;193:106647. https://doi.org/10.1016/j.compag.2021.106647
4. Su WT, Jiang LY, Tang-Hsuan O, Lin YC, Hung MH, Chen CC. AIoT-cloud-integrated smart livestock surveillance via assembling deep networks with considering robustness and semantics availability. IEEE Robot Autom Lett. 2021;6(4):6140-6147. https://doi.org/10.1109/LRA.2021.3090453
5. Nozari H, Szmelter-Jarosz A, Ghahremani-Nahr J. Analysis of the challenges of artificial intelligence of things (AIoT) for the smart supply chain (case study: FMCG industries). Sensors. 2022;22(8):2931. https://doi.org/10.3390/s22082931
6. Khan JI, Khan J, Ali F, Ullah F, Bacha J, Lee S. Artificial intelligence and internet of things (AI-IoT) technologies in response to COVID-19 pandemic: a systematic review. IEEE Access. 2022;10:62613-62660. https://doi.org/10.1109/ACCESS.2022.3181605
7. Said S, Ihab R, Hesham O, Abou Tabl I, Maged N, Youssef S, et al. AIOT-Arch: furthering artificial intelligence in big data IoT applications. IOP Conf Ser Mater Sci Eng. 2021;1051(1):012008. https://doi.org/10.1088/1757-899X/1051/1/012008
8. Krichen M, Lahami M, Cheikhrouhou O, Alroobaea R, Maâlej AJ. Security testing of internet of things for smart city applications: a formal approach. Smart Infrastructure and Applications: Foundations for Smarter Cities and Societies. Springer: Cham, Switzerland. 2020; pp. 629-653. https://doi.org/10.1007/978-3-030-13705-2_26
9. Arumugam K, Swathi Y, Sanchez DT, Mustafa M, Phoemchalard C, Phasinam K, et al. Towards applicability of machine learning techniques in agriculture and energy sector. Mater Today: Proc. 2022;51:2260-2263. https://doi.org/10.1016/j.matpr.2021.11.394
10. Gajjar R, Gajjar N, Thakor VJ, Patel NP, Ruparelia S. Real-time detection and identification of plant leaf diseases using convolutional neural networks on an embedded platform. Vis Comput. 2022;38:2923-2938. https://doi.org/10.1007/s00371-021-02164-9

https://doi.org/10.61577/jaiar.2024.100001