Babylonian Journal of Internet of Things
Vol.2025, **pp**. 113–120
DOI: https://doi.org/10.58496/BJIoT/2025/006; ISSN: 3006-1083
https://mesopotamian.press/journals/index.php/BJIoT

Research Article

Artificial Intelligence of Things: A Review

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ARTICLE INFO

Article History
Received 12 Feb 2025
Revised 11 Mar 2025
Accepted 10 Apr 2025
Published 01 May 2025

Keywords
Internet of Things (IoT)
Artificial Intelligence of Things (AIoT)
Edge Computing, Federated Learning
Smart Systems
Sustainability

ABSTRACT

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT), referred to as the Artificial Intelligence of Things (AIoT), has rapidly evolved into a transformative technological paradigm influencing sectors from smart cities to healthcare, agriculture, and beyond. This review explores the convergence of AI and IoT, highlighting the benefits, challenges, and socio-technical implications of their fusion. While AIoT systems promise operational efficiency, sustainability, and enhanced decision-making capabilities, they also pose pressing ethical concerns, especially around data privacy, security, and the societal impact of automation. Through a structured review of thirty recent scholarly contributions, this paper identifies major research themes, gaps in the literature, and opportunities for interdisciplinary innovation. The study emphasizes the need for balanced development—ensuring that technological advancements are accompanied by robust policy frameworks and a nuanced understanding of their social consequences. Ultimately, the paper argues for a more holistic and human-centered approach to AIoT innovation to ensure its responsible and equitable integration into society..

1. INTRODUCTION

Decision-making is data-driven these days and technology has subtly crept into don't just all aspects of life. AI and IoT — and two worlds that, when married with one another, deliver to us what some are beginning to call the Artificial Intelligence of Things, or AIoT — are on the core of this shift. What used to simply be done by a device is now busy sensing the surroundings and making intelligent decisions based on info collected from devices “chained” to it. From healthcare to agriculture—and even to how cities are managed—industry is waking up to AIoT potential, making a closer look at its promise pretty important [1]. A series of studies have demonstrated how AIoT has evolved, from enhancing urban living to providing assistance with guardianship of the environment [2]. In smart cities, for example, AIoT has helped dial up resource efficiency, which in many cases could nudge us toward those big Sustainable Development Goals [3]. Most conversations about AIoT are at least positive, but not all; there’s talk of data privacy woes, of communicative slow-downs and an urgent-call for experts from far and wide to come to the table [4]. For instance, in [30], optimal transport was employed to fine-tune federated learning frameworks in AIoT systems so that the efficiency would increase while also providing privacy. And remember, some minds call for a better, realiable way of handling of data with the help of the blockchain [5]. But despite all this progress, we still don’t know the full impact of deploying AIoT all over the place. For example, there has been very little research exploring the ethical concerns associated with the way data will be used or protected in these applications [6]. On top of all that there is the whole employment landscape—automation is shaking up the status quo and leaving a lot of us scratching our heads as to what the future looks like for traditional employment [7]. Even most studies zoom in on the tech advances, neglecting social and cultural aspects that can affect how people adapt to these new systems [8]. More generally, in the big picture, AIoT gets a thumbs-up for its game-changing potential, from the majority of literature, but also gets an eye-roll for the wrong backdrop from existing rules and policies [9]. This review aims to knit together our knowledge about AIoT by extracting its mixed impacts, challenges, and golden opportunities. The coming sections embark on a nonlinear journey across topics, interspersing knowledge from research on [10] AI-enabled sustainable projects with [11] intelligent infrastructure educated enhanced healthcare services. By following the evolution of AI and IoT as they expanded and converged in disparate domains, we hope to highlight some obvious chasms and propose new pathways for research [12]. In general, as the AIoT continues to develop, understanding its implications on society will be critical to creating policies and processes that ensure these innovations remain responsible and responsive [13]. Bridging these gaps isn’t simply an

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academic exercise—it is essential to ensure that novel thinking in AIoT aligns well with our real-world needs and priorities [14]. Ultimately, even as this review provides a more tangled path to projects connecting the promising opportunities and daunting obstacles ahead for the burgeoning world of AIoT, it does so by offering a more broad, if sometimes tangled, view of the available literature [15].

2. METHODOLOGY

To construct a comprehensive and balanced review of the Artificial Intelligence of Things (AIoT), a structured literature selection and analysis process was employed. The methodological approach was designed to ensure the inclusion of high-quality, relevant, and impactful research studies that reflect current trends, challenges, and opportunities within the AIoT domain.

2.1. Data Source and Selection Criteria

The main source of literature for the review was the Scopus database due to its wide coverages of peer-reviewed publications and its strong citation index. A focused search was undertaken with a series of relevant keywords such as "Artificial Intelligence of Things," "AIoT," "AI and IoT integration," "Edge AI," and "smart systems," etc. Using Boolean operators, the search was further narrowed, creating a contextually sensitive and relevant result set.
Based on the following inclusion criteria, 30 research articles were selected from the search results:

- Alignment with AIoT: The paper should be closely related to the integration of AI and IoT, either theoretically or through relevant applications.
- Citation Count: Preference was given to papers that were highly cited, which are a common measure of academic and practical impact.
- Recent Publications: To embody the recent advancements, articles published between 2020 and 2025 were preferentially included.
- **Availability** Of Metadata: Every selected article had a well-defined title, abstract, and keywords that were used as parameters for assessment, keyword

2.2. Analytical Procedure

Data were analysed using qualitative content analysis technique whereby the objectives, design, areas of implementation and outcomes of each selected article were explored. The keywords and abstracts were used to identify recurrent themes (e.g. federated learning, edge computing, smart environments, sustainability, ethical considerations). Of particular interest are innovative frameworks, interdisciplinary applications, and contributions that address policy or governance problems associated with AIoT systems.
To enhance clarity and transparency regarding the selected studies, a summary table (Table 1) was created to provide an overview in terms of authorship, year of publication, title, principal research focus of study, and key findings. Overall, this structured synthesis enabled the identification of research trends, knowledge gaps, and future research opportunities.

3. REVIEW OF LITERATURE

The evolution of the AIoT isn't a tidy chronological thread; it's better viewed as a series of patches of innovation and surprise that bring computer intelligence into contact with a wide range of connected devices. Much of the early work focused on connecting devices **to** each other and collecting data (the core of IoT, if we take some early reviews of architectures and protocols for an example of this [1]). Then, when it became clear that these networks could do more than just record info, researchers started considering how machine learning might sift through the data and even influence decision-making in subtle, clever ways [3]. Overall, this transition occurred more gradually and crept up on everyone to such an extent that **it** potentially led to both a deeper interaction between AI and IoT.
But switching gears, just looking at where AI and IoT intersect, you see a number of common themes coming up in the literature. One major theme is that creating a new mesh of these two technologies has the effect of accelerating how data can be processed, leading to real-time analyses — and often automated decisions — that help keep systems running smoothly [1, 2]. In clever setups such as smart cities, these innovations play out in less predictable ways — by adjusting traffic flows, reducing energy consumption, or improving urban governance [3].
Then the subject of sustainability, quite a few researchers in most instances say that AIoT is a literal game changer to be more eco-friendly in one's practices. From smart agriculture to improved environmental oversight, these tech blends appear to help achieve the SDGs [5]. One study even showcases a unique approach—AI and IoT in using thought-provoking strategies to engage mindsets for how we should utilize our resources, based on the 4R principles (Reduce, Reuse, Recycle, and Rethink) [11].

Not everything, of course, runs smoothly. And while more connectivity naturally raises questions of security — after all, when devices are all tied into one another, protecting your data becomes more complicated — **the literature also discusses this challenge seriously**. Multiple works highlight that even if it comes to a trade-off between time efficiency and safety, appropriate security protocols must be enforced to discourage data leaks from happening [7]. And it's not only tech—many are advocating for interdisciplinary teams of specialists to design holistic answers—bringing together the knowledge of computer science, urban planning and even environmental studies to truly maximize the potential of AIoT [9].

Drilling down a little into how AIoT has been researched, you see a whole range of approaches that create a rather rich image. Qualitative researchers have examined its social ripples—how smart devices may modify privacy norms or even affect culture in nudging ways [1], [2]. On the other hand, we have a very strong quantitative side, where people crunch stats and run simulations and **show** beyond a doubt that putting AI together with IoT is not just a tech fad, but can lead to a big boost in health monitoring and environmental caring [3], [4].

Indeed, much research these days combines these strategies, mixing both numbers and narratives to reflect a fuller, though sometimes messier, picture [7], [8]. For instance, one such contribution [11] presents the CODE algorithm which quite ingeniously improves federated learning in these systems. This example demonstrates how tying together theoretical concepts and real-world adjustments can lead to significant strides in communication and efficiency.

And then there's the big picture angle: theoretical frameworks. A better understanding of AIoT can be gained by piecing together some of the different strands of thought. Consider optimal transport theory: an emerging body of work has demonstrated the practical relevance of this approach in the context of one-shot federated learning [30], where privacy and resource efficiency in the distributed regime are enhanced.

So much of the conversation, though, comes back to sustainability. In particular, researchers point out that AIoT can complement sustainable development goals, from smarter energy consumption in cities to more efficient resource management [1]. But these very same discussions also signal major alarms about who has control over data and how ethical guidance can influence the direction of innovation, with data integrity a core concern [3].

Interdisciplinary dialogues have also become an important aspect of the debate—if not always in the most expected ways that put a little 'spice' in the conversation, for example labor shortages in agriculture and healthcare [5]. This mix of perspectives not only deepens our understanding of how AIoT can transform contemporary systems, but also highlights the complexities of merging diverse ideas.

All of this is a way of explaining how the combination of the second and third perspectives creates a rich, though imperfect, mosaic that encompasses all of what its promises and puzzles means in the context of today's AIoT. (see Table 1 for literature review summary)

TABLE I. LITERATURE REVIEW SUMMARY

Author	Year	Title	Main Focus	Findings
Biman Barua, Imon Barua, Mohammad Jashim, Uddin Mozumder, M. S. Kaiser	2025	Trends and Challenges in AI-Driven Microservices for Cloud-Based Airline Reservation Systems: A Review	Analyzes trends, challenges, and future opportunities of AI-driven microservices in cloud-based airline reservation systems.	AI-driven microservices can enhance dynamic pricing and customer experience, yet face issues related to data security, scalability, and costs.
Low Choon Keat, Ng Yen Phing, Tan Xuan Ying	2025	Optimizing QoE and Energy Consumption for IoT Applications in Fog Computing	Evaluates strategies to optimize Quality of Experience (QoE) and energy consumption in fog computing for IoT.	Identifies challenges like scalability and energy efficiency, and emphasizes the role of AI in resource allocation and decision-making.
Tarun Parmar	2025	Data-centric Approach to Decision Making in Semiconductor Manufacturing: Best Practices and Future Directions	Explores the impact of data-centric approaches on decision-making in semiconductor manufacturing.	Highlights the efficiency gains from using real-time data and advanced analytics, while identifying challenges in data integration and quality.
Praveen Borra	2024	Advancing Artificial Intelligence with AWS Machine Learning: A Comprehensive Overview	Presents an overview of AWS Machine Learning tools and their applications across various sectors.	While AWS offers scalability and ease of use, organizations must navigate issues such as high costs and reliance on cloud infrastructure.
Prof. Shweta D. Joshi, Prof. Vidya A. Khairnar, Prof. Suvarna V. Somvanshi	2024	A Comprehensive Study on Internet of Things (IoT): State-of-the-Art: Security Challenges, Future Directions, Applications and	Examines advancements and applications of IoT, focusing on security vulnerabilities and future directions.	Identifies critical challenges in security and data privacy, highlighting opportunities for AI and edge computing integration.

		Opportunities.		
Tanish Mathur	2024	Reviewing Optimization Techniques in Supply Chains: AI and Blockchain Perspectives	Analyzes the integration of AI and Big Data Analytics into Supply Chain Management.	Recognizes advancements, but also identifies challenges in technical-managerial alignment and operational efficiency.
Akanksha Mishra	2024	A Comprehensive Review of Artificial Intelligence and Machine Learning: Concepts, Trends, and Applications	Reviews foundational concepts and applications of AI and Machine Learning.	Highlights current trends in ethical AI and challenges in data privacy and model interpretability.
Ali Talib Abbas, Dr. Manar Kashmola	2024	Enhancing Drone Internet Performance through Artificial Intelligence Algorithms: A Comprehensive Review	Analyzes AI integration with Internet of Drones (IoD) to enhance performance.	Emphasizes AI's potential to improve efficiency and collaboration among drones in various applications.
Swetha Chinta	2024	Edge AI for Real-Time Decision Making in IoT Networks	Reviews Edge AI techniques for enhancing decision-making in IoT.	Demonstrates significant improvements in latency and bandwidth use, highlighting future applications across sectors.
Zengcong Wang	2024	Research Progress on Smart Manufacturing and Quality Assurance of New Energy Vehicle Components	Explores the integration of smart manufacturing with quality assurance in new energy vehicles.	Suggests that integrated frameworks can improve production efficiency and product quality.
Shalini Saha, Kushal Banerjee, Sandhita Ghosh, Samriddha Mitra, Debrupa Pal	2023	AI-Driven Edge Computing for IoT: A Comprehensive Survey and Future Directions	Surveys AI-driven edge computing applications in IoT.	Identifies advancements in efficiency and response time while calling for further exploration of adaptive mechanisms.
Salwa Othmen, Wahida Mansouri, Radhia Khdhir	2025	Applying Artificial Intelligence Techniques For Resource Management in the Internet of Things (IoT)	Develops a resource management method using AI in smart cities.	Proposes a method that significantly decreases resource allocation failures and waiting times.
Sukjun Hong, Seongchan Park, Heejun Youn, Jongyong Lee, Soonchul Kwon	2024	Implementation of Smart Farm Systems Based on Fog Computing in Artificial Intelligence of Things Environments	Implements AIoT systems for agricultural efficiency using fog computing.	Demonstrates a reduction in data volume and improved performance in agricultural IoT applications.
Gagan Dangwal, M. Wazid, Sarah Nizam, Vinay Chamola, A. K. Das	2024	Automotive Cybersecurity Scheme for Intrusion Detection in CAN-Driven Artificial Intelligence of Things	Proposes an efficient intrusion detection system for CAN-based AIoT applications.	Successfully detects various attacks without increasing communication traffic.
P. Popova, Mariana Petrova	2024	The Role of AI for Smart Environments based on Big Data and IoT Applications	Investigates AI integration in IoT and Big Data for smart environments.	Highlights AI's capabilities in optimizing operations and real-time decision-making.
Živilė Vilkelytė, Jerzy Wojciechowski, Piotr Bojarczak, Saad El Fallah, Jaouad Kharbach, Mohammed Ouazzani Jamil, Jonas Vanagas	2024	A Review on Improvement in Detection of Cyberattacks Using Artificial Intelligence for the Grid Applications	Explores AI's role in enhancing cybersecurity for smart grid applications.	Identifies challenges in implementing AI solutions for current cyber threats.
Et al. C. Ramakrishna	2023	A Smart System for Future Generation based on the Internet of Things Employing Machine Learning, Deep Learning, and Artificial Intelligence: Comprehensive Survey	Comprehensively surveys IoT applications powered by AI.	Stresses the importance of advanced technologies in enhancing environmental intelligence.
Yue Wang, Zhi Tian, Xin Fan, Yan Huo, Cameron Nowzari, Kai-Na Zeng	2022	Distributed Swarm Learning for Internet of Things at the Edge: Where Artificial Intelligence Meets Biological Intelligence	Proposes a Distributed Swarm Learning framework for IoT devices.	Addresses challenges in edge learning by integrating AI and swarm intelligence for better performance.
Md Eshrat E. Alahi, Arsanchai Sukkuea, Fahmida Wazed Tina, Anindya Nag, Wattanapong Kurdthongmee, Korakot Suwannarat, Subhas	2023	Integration of IoT-Enabled Technologies and Artificial Intelligence (AI) for Smart City Scenario: Recent Advancements and Future	Explores the integration of IoT and AI in smart cities.	Highlights the role of IoT and AI in enhancing urban living conditions.

Chandra Mukhopadhyay		Trends		
Raghubir Singh, Sukhpal Singh Gill	2023	Edge AI: A survey	Surveys the applications of AI at the network edge.	Identifies challenges and potential solutions for deploying AI in edge computing.
Kai Li, Yingping Cui, Weicai Li, Tiejun Lv, Xin Yuan, Shenghong Li, Wei Ni, Meryem Simsek, Falko Dressler	2022	When Internet of Things Meets Metaverse: Convergence of Physical and Cyber Worlds	Investigates the integration of IoT into the Metaverse.	Highlights essential technologies for enhancing mixed-reality experiences.
Jing Zhang, Dacheng Tao	2020	Empowering Things With Intelligence: A Survey of the Progress, Challenges, and Opportunities in Artificial Intelligence of Things	Surveys how AI empowers IoT applications.	Emphasizes AI's role in enhancing IoT performance and identifies critical challenges.
Shuai Yu, Xu Chen, Zhi Zhou, Xiaowen Gong, Di Wu	2020	When Deep Reinforcement Learning Meets Federated Learning: Intelligent Multitimescale Resource Management for Multiaccess Edge Computing in 5G Ultradense Network	Introduces a multitimescale approach for resource management in 5G networks.	Proposes a framework to optimize resource allocation and enhance efficiency.
Ravi Lakshmanan, Mohamed Djama, Sathish Kumar Selva Perumal, Raed Abdulla	2020	Automated smart hydroponics system using internet of things	Designs an IoT-based automatic hydroponics system.	Enhances crop management efficiency and proposes integrating AI for further improvements.
Shadi Al-Sarawi, Mohammed Anbar, Rosni Abdullah, Ahmad B. Al Hawari	2020	Internet of Things Market Analysis Forecasts, 2020–2030	Analyzes and forecasts the IoT market growth.	Predicts a 20% annual growth rate in IoT, driven by integration with AI and Big Data.
Samad M. E. Sepasgozar, Reyhaneh Karimi, Leila Farahzadi, Farimah Moezzi, Sara Shirowzhan, Sanee M. Ebrahimzadeh, Felix Kin Peng Hui, Lu Aye	2020	A Systematic Content Review of Artificial Intelligence and the Internet of Things Applications in Smart Home	Systematically reviews IoT applications in smart homes.	Identifies significant gaps in AI and IoT integration for energy efficiency.
Khaled B. Letaief, Yuanming Shi, Jianmin Lu, Jianhua Lu	2021	Edge Artificial Intelligence for 6G: Vision, Enabling Technologies, and Applications	Proposes a framework for integrating edge AI into 6G networks.	Highlights the importance of edge AI for improving efficiency and addressing privacy concerns.
Xuesong Zhai, Xiaoyan Chu, Ching Sing Chai, Morris Siu-Yung Jong, Andreja Istenič Starčič, Michael Spector, Jia Liu, Yuan Jing, Yan Li	2021	A Review of Artificial Intelligence (AI) in Education from 2010 to 2020	Analyzes the application of AI in education and identifies trends and challenges.	Identifies key research trends and emphasizes the need for interdisciplinary collaboration in education.
Chiang Y.-H., Terai K., Chiang T.-W., Lin H., Ji Y., Lui J.C.S.	2024	Optimal Transport-Based One-Shot Federated Learning for Artificial Intelligence of Things	Introduces an optimal transport-based method for federated learning in AIoT.	Achieves improved efficiency in model aggregation while enhancing privacy in AIoT systems.

4. CONCLUSION

AIoT sits right at the crossroads of smart machines and everyday connected devices—a fusion that's been explored across areas like healthcare, agriculture, and even the way our cities run. This blend of artificial intelligence with the Internet of Things isn't just about boosting how devices perform via better data crunching and decision-making; it also helps spark the creation of clever, resource-saving ideas that push us toward Sustainable Development Goals (SDGs). Studies keep pointing out that improved operational efficiency and environmental sustainability come hand in hand with real-time data handling and automated responses, especially in the context of smart cities. One can say that the shift in approach—using newer ideas like optimal transport theory to smooth out federated learning—has really reset the bar for prioritizing speed along with keeping data secure. Even if the research shows AIoT's power to transform things, it also reveals some pretty obvious gaps. Ethical issues about using data and protecting privacy, for example, don't get enough attention, which could chip away at public trust in these innovations. There's also the curious case of how different cultural and social factors shape which innovations get adopted—a topic that still begs more inquiry. And then there's the whole matter of job changes brought on by more automation; these employment shifts have some critical questions still waiting for clear answers. All this evidence nudges us to think beyond the theory. There's a clear signal that robust policy frameworks are needed to make sure AIoT rolls out responsibly in the real world. Basically, as AIoT continues to

gain ground as a game changer, industry players are being urged to team up across disciplines—pulling insights from computer science, environmental studies, sociology and the like—to craft innovations that keep ethical and social concerns in check. The growing call for tighter security in AIoT systems shows that, often, the trick is to balance being well-connected with keeping data safe. Of course, much of the current research leans heavily toward the technical side of things, sometimes overlooking the wider societal impacts. It seems that future studies should widen their scope, not only measuring how well the technology works but also considering the various social and economic settings where AIoT kicks in. In most cases, digging deeper into the ethical rules and governance models that surround these systems will be key for promoting fair and lasting benefits. In conclusion, AIoT unfolds as a multi-layered field brimming with both promise and plenty of challenges. The literature makes it clear that we have to give equal weight to the technical as well as to the ethical, social, and economic dimensions of these systems. By merging tech progress with what society needs, stakeholders can drive real, thoughtful innovations across different sectors. This review not only lays down a solid foundation for our ongoing discussions about AIoT but also outlines a roadmap for future work that's vital to keeping the technology's growth aligned with society's best interests. The road toward fully capturing AIoT's potential is deeply tied up with the evolution of both policy choices and social standards, pointing to a shared commitment—albeit with a few hiccups here and there—to build an intelligent, sustainable future.

Conflicts Of Interest

The paper states that there are no personal, financial, or professional conflicts of interest.

Funding

The absence of any funding statements or disclosures in the paper suggests that the author had no institutional or sponsor backing.

Acknowledgment

The author acknowledges the support and resources provided by the institution in facilitating the execution of this study.

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