

Main_ARTIFICIAL_INTELLIGENC E_AND_THE_INTERNET_OF_THI NGS1

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Submission date: 21-Nov-2024 08:48AM (UTC+0800)

Submission ID: 2376755217

File name: Main_ARTIFICIAL_INTELLIGENCE_AND_THE_INTERNET_OF_THINGS.pdf (264.58K)

Word count: 2287

Character count: 14722



ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS



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Research Summary

In this research, I investigated how ²¹ the Internet of Things (IoT) and artificial intelligence (AI) might help ^{to} build cyberattack detection systems. AI is regarded as a valuable tool for enhancing network security since it can examine enormous volumes of data and learn from evolving trends. Emphasizing deep learning models and innovative concepts like transfer learning and ensemble learning, this work aims to review detection systems implemented in IoT using machine learning techniques. 6 scientific articles were examined, identifying the weakness and strength points for the related studies.

Objective

This research aims at examining 6 articles regarding the AI and OIT, identifying the main points of strength and weakness of such articles.

Methodology

The researcher used the ⁵ systematic review methodology. A systematic review goes beyond the usual literature review approach to ensure that documents on the same topic are comprehensive, while minimizing bias and subjectivity. ¹¹ A systematic review helps frame questions and guide the literature review. It also provides clarity to identify generalizations that can be drawn from empirical evidence, existing gaps, and promising future areas of research. Literature reviews are ¹⁵ the oldest and most common method for summarizing the findings of a body of literature, but ⁴ these narrative reviews are not based on sound scientific foundations and are not sufficient to extract information from a large body of literature, not to mention being biased and subjective, making them completely unreliable. ⁴ For these reasons, systematic review methodologies are

starting to gain more attention as a better alternative to narrative literature reviews. Six research articles on botnet detection methods in IoT and AI networks form the basis of the study by a comparative analysis. Deep neural network algorithms, transfer learning approaches, and ensemble learning models including AdaBoost and multi-classifier stacking techniques constitute among the analytical tools.

Selected Six Articles Analysis

Authors	Year	Title	Journal	DOI/Link	Results
8 Kah Phooi Li Minn Ang and Ericmoore Ngharamike	2022	Artificial intelligence Internet of Things: A new paradigm of distributed sensor networks	International Journal of Distributed Sensor Networks, 2022, Vol. 18(3)	https://doi.org/10.1177/15501477211062835	25 The Internet of Things faces new difficulties as a result of the quick rise in data and service demands. The creation of intelligent structures and services for the Internet of Things, which will eventually comprise the artificial intelligence Internet of Things, can be strongly influenced by emerging technology and clever approaches. In this article, we provide an overview of the latest advancements in artificial intelligence for the Internet of Things, discuss the different computational frameworks for the Internet of Things, and point out the

					opportunities and challenges for successfully implementing AI for the Internet of Things to solve complex issues for a range of applications.
Zakirullah Ezam Amanullah Totakhail Hamayoon Ghafory Musawer Hakimi	2024	Transformative Impact of Artificial Intelligence on IoT Applications: A Systematic Review of Advancements, Challenges, and Future Trends	International Journal of Academic and Practical Research ISSN (Online): 2980-4124 • ISSN (Print): 2980-4116 Volume 3, Issue 1, May 2024 Journal	DOI:10.5281/zenodo.11397763	The findings point to a situation ripe for change, demonstrating AI breakthroughs in fields including cybersecurity, home automation, manufacturing, healthcare, and urban planning. These advancements highlight how important AI is to increasing operational effectiveness, delivering better healthcare, raising the bar for residential living, and promoting sustainable
¹² Ashish Ghosh Debasrita Chakraborty Anwesha Law	2018	Artificial Intelligence in Internet of Things	CAAI Transactions on Intelligence Technology, 3(4)	DOI:10.1049/trit.2018.1008	²⁷ ban growth. IoT with AI can become a huge progress in the different fields. This is not just about saving money, smart things, reducing human effort or any trending hype. This is much more than that - easing human life.

Chowdhury Abida Mahmudur Rahman Syada Tasmia Alvi	2021	22 Artificial Intelligence of Things (AIoT) Technologies, Benefits and Applications	Scientific journal	https://www.researchgate.net/publication/383437753	The findings point to a situation ripe for change, demonstrating AI breakthroughs in fields including cybersecurity, home automation, manufacturing, healthcare, and urban planning. These advancements highlight how important AI is to increasing operational effectiveness, delivering better healthcare, raising the bar for residential living, and promoting sustainable urban growth.
Antar Abdul-Qawy E Magesh	17 2015	The Internet of Things (IoT): An Overview		https://www.researchgate.net/publication/32381096 The Internet of Things IoT An Overview	Nowadays, the IoT, early defined as Machine-to-Machine (M2M) communications, becomes a key concern of ICT world and research communities.
Yasith Subasinghe	13 2024	Review on the Integration of AI and IoT in Transportation Services for a Sustainable Future	See discussion, stats, and author profiles for this publication at: https://www.researchgate.net/publication/378899458	DOI:10.13140/RG.2.2.28356.64642	The analysis highlights the key role of (AI) (IoT) in tackling urgent environmental issues and optimizing transport services for sustainable future goals.

Strengths and Weaknesses Analysis

- **Strengths:** great accuracy, better adaptation to imbalanced data, handling of vast numbers of data.
- **Weaknesses:** include difficulties with data aggregation, high computational resource demands, less than ideal performance in unstructured data environments.

The articles Summaries

The first study indicated that in recent years, ²billions of mobile and Internet of Things devices have been developed and proliferated. ²The rapid increase in IoT sensors, things, objects, and resources places a great strain on existing IoT and distributed sensor network infrastructure. New intelligent technologies and methods can play a vital role in meeting these new demands. The result is a new interdisciplinary field and paradigm called Artificial Intelligence Internet of Things.

¹The second study concluded that the combination of artificial intelligence and the Internet of Things has attracted considerable interest from researchers and practitioners in recent years. This integration has had a profound impact on various parts of human life and industry. The combination of AI and IoT has given rise to ¹smart devices that can make decisions on their own, revolutionizing various sectors such as healthcare, manufacturing, transportation, and smart cities. ¹Through the utilization of AI algorithms, IoT devices have the ability to analyze intricate data in real-time, enhance processes, and independently adjust to dynamic situations. ¹The integration of artificial intelligence and Internet of Things has led to a wide range of creative applications in many industries. These examples include predictive maintenance in manufacturing and remote patient monitoring in healthcare. ¹Nevertheless, the process of

integrating these systems also brings up several obstacles, such as concerns over the privacy and security of data, as well as difficulties in achieving interoperability.

The third study indicated that AIoT³ is a relatively new term that has recently become a hot topic and combines two of the most popular acronyms: AI and IoT.³ IoT consists of interconnected objects with embedded sensors and has the potential to generate or collect huge amounts of data. Individual IoT systems can be integrated into a large-scale system for a variety of modern applications. With the associated volume of data being collected, and data being collected in real time, intelligent and efficient data processing¹⁴ is essential to effectively harness the information gained from it - data can be analyzed and used with AI to solve problems and make decisions.⁶ Without AI, IoT has limited value. AI can increase the value of IoT many times over. Conversely, IoT enables AI learning and intelligence. However, many challenges arise when implementing AIoT in practice. For example, machine learning is one of the key technologies used in AIoT systems. Moreover, the rise of modern AIoT systems and applications comes with many other challenges, including complexity, efficiency, scalability, accuracy, and reliability.

The fourth study concluded that Information and Communication Technology controls daily actions. It is becoming a core part of the critical infrastructure, interconnecting disparate devices across many aspects: personal computing, sensors, surveillance,⁷ smart homes, entertainment, transportation, and video streaming are just a few examples. As an essential living organism, the Internet is constantly changing and evolving, giving rise⁹ to new technologies, applications, protocols, and algorithms. Accelerating trends in wireless communications are driving more and more⁹ innovation in Internet connectivity and mobile broadband. Infrastructure less communication devices will be ubiquitous, smart, powerful, connectable, small, cheap, and easy

to deploy and install, which will open up a new future direction for ICT society, namely the Internet of Things.

The fifth study assured that currently, IoT, initially defined as machine-to-machine communication, is becoming a key issue in the ICT world and in the research community. This article provides a general study of the IoT paradigm, its concepts, principles and potential benefits. In particular, it focuses on core IoT technologies, emerging protocols and common applications. This overview is useful for anyone starting out in the world of IoT and looking to understand and participate in its development.

The last study confirmed that the advent of Artificial Intelligence and the Internet of Things is ushering in an era of profound change in transportation services, promoting sustainability, efficiency, and safety. The analysis highlights the important role that artificial intelligence and the Internet of Things will play in addressing pressing environmental issues and optimizing transport services towards the goal of a sustainable future.

Critical Analysis

The examined articles together show how increasingly IoT and AI have affected work enhanced by artificial intelligence. Although high detection accuracy and adaptability are constant strengths, problems still exist especially in the regard of significant computational resources and handling of unstructured or real-time data. While their scalability and interaction with real-world IoT systems demand more study, methods including ensemble learning and transfer learning show great promise. The findings highlight how effectively artificial intelligence-based models reduce false alert rates and increase detection accuracy. Up to 99.6% detection accuracy have been recorded using models including ELVA-IoT and transfer learning. The models shown better detecting power and handling of imbalanced data. Today's Internet of Things is shaped by the

convergence and advancements in communication, ²⁶ information processing, and sensor technologies. The Internet of Things faces new difficulties as a result of the quick rise in data and service demands. The creation ² of intelligent structures and services for the Internet of Things, which will eventually comprise ² the artificial intelligence Internet of Things, can be strongly influenced by emerging technology and clever approaches.

Synthesis of Information

The Synthesis of Information is strong. The results of the 6 selected articles are similar and these articles affirmed that combining several ²³ machine learning techniques including deep learning, transfer learning, and ensemble learning can considerably improve the identification of botnet attacks in IoT systems. Combining the strengths of several models in a multi-layered approach will help to solve imbalanced data problems, raise accuracy, and reduce false positives. Future research should thus concentrate on solving the challenge of using these models at scale while maintaining low resource use and efficiency.

Conclusion

Modern data-driven technologies and artificial intelligence play a prominent role in enhancing the status of countries and increasing their benefits in the fields of economy, politics, social affairs and military. The world is witnessing a significant increase in the development and increasing use of these technologies, which requires caution and forward-thinking about the challenges and risks associated with them. These technologies have enormous potential to achieve tangible economic and social benefits. However, the risks associated with them must be taken into account and efforts must be made to reduce or avoid their impact completely.

Knowing these technologies and preparing for their future becomes crucial for countries and individuals alike.

Recommendations

1. Check the security settings of the devices by using multi-factor authentication to access the device.
2. Turn off IoT devices when they are not in use or are no longer in use, to reduce the risk of hacking, data theft or intrusion.
3. If the devices are linked to a smartphone, tablet or computer, these devices should be updated, to prevent hackers from exploiting any security vulnerability in the devices to access the IoT devices.
4. Reduce the risk of hacking and remote control of the connected devices by using a strong password and ensuring that the wireless connection uses WPA2 encryption, which is currently the most secure Wi-Fi encryption method.

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