INVERTED: **Journal of Information Technology Education**
p-ISSN: 2828-2094, e-ISSN: 2828-2330
http://ejurnal.ung.ac.id/index.php/inverted
Vol 5, No 1: Januari 2025

Review IoT Subject: Trends And Challenge For Research And Publication

Ulfatun Nadifa*[1], Yasin Mohamad[2], Bambang Panji Asmara[3], Haeriani H[4], Aristi Ayuningsi Ode Asri[5], Rahmat Hidayat Dongka[6], Sri Ayu Ashari[7], Wahyu Saputra[8], Nur Mutmainnah[9]

[1]Program Teknik Komputer, Universitas Negeri Gorontalo, Indonesia
[2,3,6]Program Teknik Elektro, Universitas Negeri Gorontalo, Indonesia
[4,7]Program Teknologi Informasi, Universitas Negeri Gorontalo, Indonesia
[5]Program Teknik Sipil, Universitas Negeri Gorontalo, Indonesia
[8,9]Program Teknik Arsitektur, Universitas Negeri Gorontalo, Indonesia
e-mail: ulfatun@ung.ac.id

Abstract

The Internet of Things (IoT) has emerged as a transformative technology that is revolutionizing various industries and everyday life. This study aims to explore current trends and challenges in IoT research and publication. The research method employed in this study begins with a blind search across various international journal databases, followed by ranking the minimum and maximum percentages of each IoT subject. The journal databases used include IEEE, Science Direct, Taylor and Francis, and NATURE. Subjects with minimal rankings or IoT journal topics with the lowest percentages in each database were then reviewed based on predetermined filters. The blind search results revealed that IoT subjects with the lowest percentages were IoT Smart Farming at 0.87%, IoT Smart Bin at 1.54%, and IoT Smart Water at 2.73%. A review was subsequently conducted on journals covering IoT subjects to identify trends and challenges related to techniques, tools, and objects in the subjects with the lowest percentages.

Keywords: *Challenges, IoT Subject, Trands,*

INTRODUCTION

IoT is a system that enables various ordinary devices to connect to the internet to achieve diverse goals. The Internet of things (IoT) describes the network of physical objects “things” that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet (Bhimrao Shendge, 2021). With the highly diverse functions of IoT, it is essential to understand the current progress and research related to the subject of IoT. Although the concept of IoT has existed for a long time, it is known that many suggestions regarding this technology, such as low-cost low-power sensors, cloud and advanced computing, machine learning, and data analytics, have made it one of the most important technologies of the twenty-first century (Debnath & Chettri, 2021). To address the current challenges, it is necessary to outline the trends and challenges related to the IoT subject. By proactively addressing these challenges, the full potential of IoT can be realized while ensuring a secure, operable, and socially acceptable IoT ecosystem (Yaqoob et al., 2017).

This journal aims to identify: (i) the percentage of journals published in each international journal database; (ii) trends related to techniques, tools, and objects in IoT subjects; (iii) and challenges related to IoT subjects with the lowest ranks in each journal database. Given the rapid development and diverse applications of IoT, it is important to systematically review these trends and challenges. Identifying key research topics and relevant publication platforms is crucial for researchers who want to make meaningful

contributions in this dynamic field. This paper focuses on the analysis of IoT subjects, publication trends across major databases, as well as the challenges and opportunities faced by researchers, providing a comprehensive overview for future studies and technology development.

REASEARCH METHOD

In this study, several stages of journal review are applied. Below is an illustration of the journal review process stages.

Figure 1. Research Method

The figure above illustrates the steps of the research method to achieve the research objectives, which consist of:

1. Determining the research boundaries based on the research question (RQ): The formulation of the RQ is aligned with the research objectives, and in this study, three research questions are created, which will be explained in the next section.
2. Search Term: These research questions assist in selecting articles and determining the rank of the IoT subject.
3. Filtering articles from online databases is conducted in two stages: The first stage, called filtering B1, is based on the subject rank and publication year, while filtering B2 involves analysis the content of the articles to answer the research questions.
4. Data Analysis: Once relevant articles are obtained for this study, data analysis is carried out by calculating data percentages. The results of the percentage data analysis and presented in a table to explain the review.

A. Databased Journal

In this study, several internationally recognized journal databases were used as sources to find articles related to the subject of the Internet of Things (IoT). The selected databases include IEEE, Taylor & Francis, Nature, and ScienceDirect. These databases are popular and credible platforms for IoT topics, offering access to cutting-edge research across various fields of science. This approach refers to methodologies previously applied in other studies, which utilized international journal databases to conduct systematic reviews or comprehensive evaluations of relevant literature (Nadifa et al., 2022). By selecting these databases, it is expected to identify high-quality articles and gain comprehensive insights, thereby supporting the validity and accuracy of the research findings.

B. Research Question

The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

C. Search Terms

Table 1. Subject of Search Term

No.	SUBJECT
1	IoT Network
2	IoT Sensor
3	IoT Data
4	IoT Security
5	IoT Gateway
6	IoT Architecture
7	IoT Edge
8	IoT Healthcare
9	IoT Monitoring
10	IoT Smart City
11	IoT Smart Energy
12	IoT Smart Grid
13	IoT Smart Farming
14	IoT Smart Water
15	IoT Smart Bin

Search terms refer to the keywords used to search for journals related to IoT subjects as search terms. From these search terms, data is obtained on the number of journals from each journal database, namely IEEE, Springerlink, Nature, and Science Direct, which are then used to determine the percentage and ranking of each subject across all the mentioned journal databases. *Table 1* presents the 15 IoT subjects used as search terms.

D. Filtering

Filtering at this stage is carried out in two steps. The first step (B1) involves filtering journals from IoT subjects with the lowest ranking in each journal database based on searches from the last 5 years. The second step (B2) involves filtering by answering each research question that has been previously formulated in the research questions.

E. Data Analysis

Data analysis is performed using percentage and ranking formulas. The percentage is used to determine the comparison of each subject in the journal databases. Then, ranking is done to determine the highest and lowest-ranked subjects, which will then be used to select journals for the filtering stage. After the journals passing the first filtering are selected, data analysis will be conducted to answer the research questions that have been set.

RESULT AND DISCUSSION

Table 2. Max and Min Ranking of Subject

Based On Subject /Databased Journal		Rank	Persentase
Max	IOT Data	1	15,94%
	IOT Network	2	14,93%
	IOT Sensor	3	10,50%
Min	IOT Smart Farming	1	**0,87%**
	IOT Smart Bin	2	**1,54%**
	IOT Smart Water	3	**2,73%**

Table 2 is generated from a blind search to determine the percentage of each subject in the journal databases. It is found that there are four IoT subjects with the lowest percentages: IoT Smart Farming at 0.87%, IoT Smart Bin at 1.54%, and IoT Smart Water at 2.73%. These results can be considered for future research to select IoT subjects that are less studied, increasing the chances of journal publication and making a more meaningful contribution to these subjects. Topics with minimal rankings also present unique challenges in finding references, although their novelty is greater. Therefore, this study also needs to examine IoT subjects based on each database, as this will help researchers in finding references related to broader IoT subjects.

Based on Table 3, the ranking of IoT subjects by database, the rankings are divided into two categories: minimal and maximal rankings. The minimal ranking represents IoT subjects with the smallest percentage out of the total 15 IoT subjects, while the maximal ranking refers to the top three rankings in each database.

A. Filtering Journal

After determining the ranking of each IoT subject, the results are used to identify journals that will be used as samples for analyzing the research questions. At this stage, journals are also filtered based on the last five years, with minimal rankings in each journal database.

From filter A1, 20 journals were found in each journal database based on IoT subjects with minimal rankings. Next, an analysis will be conducted on the journals that passed filter A1 to proceed to filter A2 by analyzing the Research Questions.

Table 3. Max and Min Ranking of Subject Based Databased Journal

Based On Subject		Subject	Rank	Persentase
Max	Science Direct	IOT Data	1	15,33%
		IOT Network	2	13,62%
		IOT Monitoring	3	10,78%
	IEEE	IOT Network	1	25%
		IOT Data	2	20,92%
		IOT Sensor	3	11,28%
	Taylor and Francis	IOT Data	1	13,60%
		IOT Sensor	2	12,22%
		IOT Network	3	11,78%
	Nature	IOT Data	1	17,91%
		IOT Network	2	12,98%
		IOT Monitoring	3	9,95%
Min	Nature	IOT Smart Bin	1	0,49%
		IOT Smart Farming	2	0,66%
		IOT Gateway	3	1,08%
	Taylor and Francis	IOT Gateway	1	1,25%
		IOT Smart Grid	2	1,85%
		IOT Smart Farming	3	2,30%
	IEEE	IOT Smart Water	1	0,33%
		IOT Smart Bin	2	0,40%
		IOT Smart Farming	3	0,46%
	Science Direct	IOT Smart Bin	1	0,73%
		IOT Smart Farming	2	0,74%
		IOT Gateway	3	2,02%

There are four research questions used to conduct a journal review analysis based on topics with the lowest rankings in each database. The following is the analysis review for each research question.

Based on Table 4, it is shown that 17 journals are used as samples to be analyzed based on the results from the previous stage. The following is the final stage, which involves the analysis of the research question.

Table 4. Filtering Journal

Databased	B1	B2
IEEE	[5][6][7][8][9]	[5][6][7][8][9]
Science Direct	[10][11][12][13][14]	[10][11][12][13][14]
NATURE	[15][16][17][18][19]	[15][16][17][18][19]
Taylor and Francis	[20](Oh & Lu, 2023)[22][23]	[20](Oh & Lu, 2023)[22][23]

a. *RQ1: What are the Trends/Strengths of the Research?*

The following are the trends observed from the journal analysis results: Reducing the power consumption of IoT gateways by using the Discontinuous Reception (DRX) mechanism in 5G networks, Federated blockchain is implemented to enhance security, efficiency, and privacy in inter-device communication across different domains, and Scheduling techniques (BGP) and aggregation at sensor nodes can achieve significant reductions in energy consumption and network traffic.

In this case, the trend refers to the analysis related to the techniques and objectives of the research conducted. To better understand the results of the trends highlighted in the aforementioned studies, the discussion and results in this research can be used as a reference.

b. *RQ2: What are the Limitations of the Research?*

The following are the trends observed from the journal analysis results: It is known from the analysis of the research questions related to the research limitations that a frequently mentioned issue is the lack of simulation or real-world implementation details. The focus is on energy consumption, but other aspects such as scalability, security, and data integrity in IoT gateways could be explored further.

c. *RQ3: What are the Conclusions of the Research?*

The following are the trends observed from the journal analysis results: For the analysis of the research questions related to the research conclusions, various conclusions were found, ranging from an improvement in the techniques used in terms of percentages, to several research variables that were not aligned with the techniques used in the study.

d. *RQ4: What are the Challenges for Future Research?*

The following are the trends observed from the journal analysis results: The analysis results related to the research question challenges for future research include the need to explore scalability, security, or data integrity at the gateway, integration with other technologies, exploring framework integration, and authenticated encryption schemes such as AHEAD to address the simultaneous need for device authentication and data encryption. Among the challenges mentioned above, these can be used to evaluate and compare future research to make the research outcomes more meaningful.

CONCLUSION

Based on the research results and the discussion presented earlier, it can be concluded that this study provides an overview of the currently popular IoT subject, which is also discussed within the framework of subjects based on four international journal databases. From this research, the next study will focus on one specific topic for a deeper analysis of

that subject, applying techniques, and developing more meaningful research that will open up greater opportunities for journal acceptance in the available journal databases.

REFERENCE

Alumfareh, M. F., Humayun, M., Ahmad, Z., & Khan, A. (2024). An Intelligent LoRaWAN-based IoT Device for Monitoring and Control Solutions in Smart Farming through anomaly detection integrated with unsupervised machine learning. *IEEE Access*, *12*(September). https://doi.org/10.1109/ACCESS.2024.3450587

Alzubi, A. A., & Galyna, K. (2023). Artificial Intelligence and Internet of Things for Sustainable Farming and Smart Agriculture. *IEEE Access*, *11*(July), 78686–78692. https://doi.org/10.1109/ACCESS.2023.3298215

Bawankar, N., Kriti, A., Chouhan, S. S., & Chaudhari, S. (2024). IoT-Enabled Water Monitoring in Smart Cities With Retrofit and Solar-Based Energy Harvesting. *IEEE Access*, *12*(April), 58222–58238. https://doi.org/10.1109/ACCESS.2024.3392852

Bhimrao Shendge, A. (2021). Internet of Things (Iot): an Overview on Research Challenges and Future Applications. *International Journal of Engineering Applied Sciences and Technology*, *6*(8), 66–71. https://doi.org/10.33564/ijeast.2021.v06i08.011

Chandroth, J., Saxena, N., Roy, A., & Rastogi, E. (2022). A New Design and Analysis of Power Saving for IoT Gateway. *IETE Technical Review (Institution of Electronics and Telecommunication Engineers, India)*, *39*(3), 577–585. https://doi.org/10.1080/02564602.2021.1880343

Debnath, D., & Chettri, S. K. (2021). *Internet of Things: Current Research, Challenges, Trends and Applications*. *June*, 679–694. https://doi.org/10.1007/978-981-33-4604-8_52

Gabriel, A., & Cruz, F. (2023). Open source IoT-based collection bin applied to local plastic recycling. *HardwareX*, *13*, e00389. https://doi.org/10.1016/j.ohx.2022.e00389

Hasan, M. R., Rahman, M. M., Shahriar, F., Khan, S. I., Mohi Uddin, K. M., & Hasan, M. M. (2024). Smart Farming: Leveraging IoT and Deep Learning for Sustainable Tomato Cultivation and Pest Management. *Crop Design*, *3*(4), 100079. https://doi.org/10.1016/j.cropd.2024.100079

Jeyaraj, P. R., Rajan Samuel Nadar, E., & Mihet-Popa, L. (2023). Deep-Block Network for Cyberattack Mitigation and Assessment in Smart Grid Power System with Resilience Indices. *Electric Power Components and Systems*, *0*(0), 1–17. https://doi.org/10.1080/15325008.2023.2268073

Jnana Ramakrishna, C., Bharath Kalyan Reddy, D., Priya, B. K., Amritha, P. P., & Lakshmy, K. V. (2024). Analysis of Lightweight Cryptographic Algorithms for IoT Gateways. *Procedia Computer Science*, *233*, 235–242. https://doi.org/10.1016/j.procs.2024.03.213

Johncy, G., & Shaji, R. S. (2024). Secure smart grid implementation with automatic data integrity attack location prediction and exalted energy theft detection. *Connection Science*, *36*(1). https://doi.org/10.1080/09540091.2024.2403393

Kumar, M., Mukherjee, P., Verma, S., Kavita, Shafi, J., Wozniak, M., & Ijaz, M. F. (2023). A smart privacy preserving framework for industrial IoT using hybrid meta-heuristic algorithm. *Scientific Reports*, *13*(1), 1–17. https://doi.org/10.1038/s41598-023-32098-2

Lall, A. K., Terala, A., Goyal, A., Chaudhari, S., Rajan, K. S., & Chouhan, S. S. (2024).

Behavioural Analysis of Water Consumption Using IoT-Based Smart Retrofit Meter. *IEEE Access*, *12*(August), 113597–113607. https://doi.org/10.1109/ACCESS.2024.3436889

Nadifa, U., Bachtiar, F. A., Supianto, A. A., & Tolle, H. (2022). Review of Technique and Algorithm for Educational Data Mining: Trend and Challenge in Games Design. *Kinetik: Game Technology, Information System, Computer Network, Computing, Electronics, and Control*, *4*(1), 35–44. https://doi.org/10.22219/kinetik.v7i1.1349

Oh, S., & Lu, C. (2023). Vertical farming - smart urban agriculture for enhancing resilience and sustainability in food security. *Journal of Horticultural Science and Biotechnology*, *98*(2), 133–140. https://doi.org/10.1080/14620316.2022.2141666

Ramson, S. R. J., Vishnu, S., Kirubaraj, A. A., Anagnostopoulos, T., & Abu-Mahfouz, A. M. (2022). A LoRaWAN IoT-Enabled Trash Bin Level Monitoring System. *IEEE Transactions on Industrial Informatics*, *18*(2), 786–795. https://doi.org/10.1109/TII.2021.3078556

Selvanarayanan, R., Rajendran, S., Algburi, S., Ibrahim Khalaf, O., & Hamam, H. (2024). Empowering coffee farming using counterfactual recommendation based RNN driven IoT integrated soil quality command system. *Scientific Reports*, *14*(1), 1–16. https://doi.org/10.1038/s41598-024-56954-x

Wang, S., Luo, N., Xing, B., Sun, Z., Zhang, H., & Sun, C. (2024). Blockchain-based proxy re-encryption access control method for biological risk privacy protection of agricultural products. *Scientific Reports*, *14*(1), 1–25. https://doi.org/10.1038/s41598-024-70533-0

Xu, H., Liu, W. D., Li, L., & Zhou, Q. (2024). An IoT-based low-cost architecture for smart libraries using SDN. *Scientific Reports*, *14*(1), 1–15. https://doi.org/10.1038/s41598-024-57484-2

Yan, M. (2024). Receive wireless sensor data through IoT gateway using web client based on border gateway protocol. *Heliyon*, *10*(11), e31625. https://doi.org/10.1016/j.heliyon.2024.e31625

Yaqoob, I., Ahmed, E., Hashem, I. A. T., Ahmed, A. I. A., Gani, A., Imran, M., & Guizani, M. (2017). I nternet of T hings. *2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS)*, *c*(December 2019), 3507–3508.

Zhou, P., Chen, W., Wang, J., Wang, H., Zhang, Y., Cao, B., Sun, S., & He, L. (2024). GSHFA-HCP: a novel intelligent high-performance clustering protocol for agricultural IoT in fragrant pear production monitoring. *Scientific Reports*, *14*(1), 1–18. https://doi.org/10.1038/s41598-024-66631-8

Zoumpoulis, P., Konstantinidis, F. K., Tsimiklis, G., & Amditis, A. (2024). Smart bins for enhanced resource recovery and sustainable urban waste practices in smart cities: A systematic literature review. *Cities*, *152*(April), 105150. https://doi.org/10.1016/j.cities.2024.105150