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The latest trends in internet of things usage in smart homes: a systematic literature review

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ABSTRACT

The internet of things (IoT) has developed rapidly in recent years. Equipped with increasingly mature information technology, especially for use in smart homes. This technology is integrated with IoT systems, which can now solve this problem. This paper helps identify the latest research trends and provides a comprehensive overview of the factors used in intelligent housing, utilizing a systematic literature review (SLR). Recent observations indicate that using SLR can offer new insights for researchers and industry. Our findings provide definitive evidence that this phenomenon is related to changes in IoT utilization in Smart Homes. This article takes 2,256 documents from Springer, Institute of Electrical and Electronics Engineers (IEEE), Association for Computing Machinery (ACM), Multidisciplinary Digital Publishing Institute (MDPI), ScienceDirect, Hindawi, Institute of Advanced Engineering and Science (IAES), and Google Scholar. 70 articles passed the specified exclusion and inclusion criteria. However, challenges such as device interoperability, privacy, security, and sustainable energy management remain underexplored. This study uncovers significant research gaps, including the need for a holistic framework that integrates IoT, artificial intelligence (AI), and robotics. Future studies are recommended to adopt bibliometric analysis, develop a standardized IoT framework, and expand cross-disciplinary approaches.

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1. INTRODUCTION

Technology has recently become increasingly advanced, and the term "smart technology" has also emerged. One of the uses of smart technology, including actuators, sensors, and robots, placed in the home, is to enhance the quality of human life, productivity, and well-being, as well as overall well-being and daily life. Generally, smart technology improves users' quality of life by automating devices and utilizing various sensors and actuators. Smart home technology is a device that provides a certain level of digitally connected or enhanced service to residents and is often synonymous with a "home automation system" [1]. The shift from traditional to intelligent devices has fueled the rise of interoperable gadgets and contributed to the development of comprehensive, smart domestic innovation. Subsequently, this innovation is exceptionally vital, particularly in enhancing the quality of private life [2].

Smart homes utilize advanced devices to control various home components. Recently, smart home technology can evaluate environmental protocols such as heating and lighting. Almost all electrical features in the house can be utilized, including the system. On the other hand, the smart home method turns

components on and off; additionally, it can synchronize the activity and internal environment carried out while the house is occupied. The result of improving the performance of this technology, such as a smart home, could enhance the quality of user activities and see device movements independently [3]. Smart home technology utilizes many of the same components as assistive technology to develop an environment where multiple components in a home can be monitored and communicate with each other [4]. Current literature on smart homes primarily focuses on three key aspects: security and privacy challenges, energy optimization, and artificial intelligence (AI)-based automation. The literature is presented in detail in Table 1.

Table 1. Comparison of the systematic literature review (SLR) of related studies

Year	Ref.	Research focus	Contribution	Limitations
2021	[5]	Smart home security risks and challenges	Encryption-based IoT security framework	Does not address AI/robotics integration
2022	[6]	Smart home-based AI	AI algorithms for predictive automation	Focus only on device control, which does not cover security
2022	[7]	Energy efficiency	Real-time energy consumption optimization method	Minimal evaluation on a large household scale
2023	[8]	IoT for smart cities and clean energy	IoT applications for city energy management	Relevance to smart homes is still limited
2023	[9]	IoT data security	Blockchain-based data privacy model	Does not address interoperability between devices

A comparison of recent studies in Table 1 shows that most research only isolates specific aspects of the smart home rather than addressing them holistically. Despite advances in such research, existing literature reviews often analyze these aspects minimally, with limited discussion of how security, energy management, and AI integration interconnect within a holistic smart home ecosystem. This study looked into the effects of conducting internet of things (IoT) reviews, with little known about how users in smart residences utilize the latest trends in IoT applications. While previous studies investigated the impact of only smart homes, they did not explicitly address their influence on the latest trends in IoT usage in smart homes. This technology still needs robot systems and the IoT to help with their daily activities [10]. However, comprehensive home technology research and study notes on robots in IoT to help the daily lives of existing smart home residents are still lacking. To fill this gap, an SLR study in this research was conducted to find IoT technology to help implement smart homes.

There is a lack of a comprehensive, SLR that synthesizes recent IoT-driven smart home advancements, particularly the convergence of automation, robotics, and energy management into a unified framework. A literature search in journals such as the Institute of Electrical and Electronics Engineers (IEEE) IoT Journal, Association for Computing Machinery (ACM) Transactions on Internet Technology, and Elsevier Future Generation Computer Systems (2019-2025) identified over 120 studies. However, approximately 10% specifically examined the relationship between IoT and robotics in supporting everyday life in smart homes. However, only the SLR systematically evaluated these studies using quality assessment criteria and through the proper stages. This resulted in fragmented and poorly applicable findings involving numerous devices. This situation highlights a critical research gap: the absence of a comprehensive SLR that can synthesize recent advances in IoT-based smart homes, particularly the convergence of automation, robotics, and energy management, into a unified framework.

Therefore, the contribution and aim of this study are to propose a novel categorization with mapped IoT technologies. Include a visual timeline or trend map showing the evolution of smart home IoT applications over the past decade. The authors aimed to conduct a systematic review of studies indexed on major platforms (IEEE, ACM, and Elsevier) from January 2019-2025, focusing on IoT-based smart home technologies. This was done to ensure that the review reflected the latest developments in automation, security, and energy management.

We hope that this SLR research can help researchers and industry study the use of IoT in smart homes. Section 2 explains the method, section 3 presents the results, and section 4 answers the main research questions formulated in our SLR study. Section 5 presents the conclusions.

2. METHOD

This research employs the SLR approach, following the guidelines outlined by Kitchenham in research [11] to ensuring repeatability, transparency, and rigor in identifying research trends, especially in IoT-based smart home systems. The review methodology consists of three main phases: planning, implementation, and reporting in Figure 1. Each step was predefined to minimize selection bias and ensure consistent application of inclusion and exclusion criteria, see Figure 1.

2.1. Planning

2.1.1. Research question (RQ)

The section talks about a stage of SLR research, see Figure 1, because the author needs to explain the questions in the SLR study. The research focuses on the latest use of IoT in smart homes. Several stages that can be compiled in this research are:

- RQ1: what are the latest trends of IoT adoption in smart homes (2019-2025)?
- RQ2: what motivates and benefits drive the use of IoT in smart homes?
- RQ3: what factors influence the implementation of IoT (technical, social, and economic)?
- RQ4: how are the reviewed studies distributed by geography and publication year?

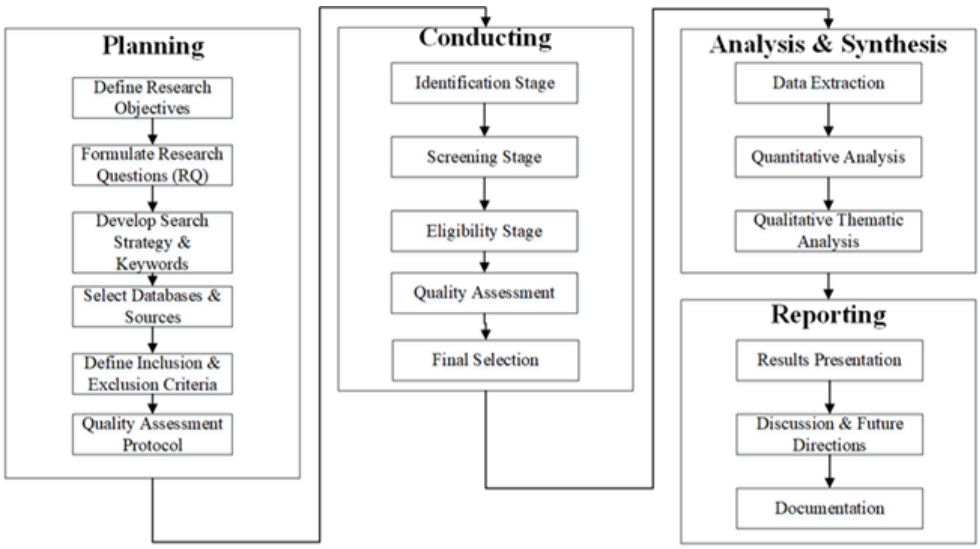

Figure 1. SLR for reviewing the latest trends in IoT usage in smart homes (adopted from [11])

2.1.2. Search string (keyword strategy)

Some rules can allow searching for phrases or words that have the same Boolean meaning, “OR” and “AND” used in searching for a list of studies from articles on the internet, such as ("IoT" OR "Internet of Things") AND ("Smart Home" OR "Smart Homes") AND (("IoT" OR "Internet of Things") AND ("Smart Home" OR "Home Automation") AND ("Matter protocol" OR "Thread protocol" OR "federated learning" OR "privacy-preserving" OR "ambient intelligence" OR "voice control").

2.1.3. Database source

The Author's review, capacities, and instruments with some studies identified with the latest trends in IoT for smart homes are selected based only on ACM, IEEE, ScienceDirect, Multidisciplinary Digital Publishing Institute (MDPI), Springer, Google Scholar, and Institute of Advanced Engineering and Science (IAES).

2.1.4. Exclusion and inclusion criteria

Exclusion of the article does not provide an overview of the latest trend research developments in IoT in the Smart Home. Inclusion of the SLR research was compiled using English as a selected and international language, determining the years 2020-2025. The results of the filtered studies talk about the latest trend research developments in IoT in the smart home. The criteria are summarized in Table 2.

Table 2. Comparison of inclusion and exclusion

Criteria	Inclusion	Exclusion
Publication type	Peer-reviewed journals/conferences	Editorials, white papers, theses, and patents
Language	English	Non-English
Timeframe	Jan 2019-Jul 2025	Before 2019
Topic relevance	Direct relevance to IoT in smart homes	General IoT or unrelated IoT domains
Accessibility	Full-text available	Paywalled or inaccessible papers

2.1.5. Quality criteria

In this section, the author will explain in detail the quality criteria (QC) used to determine the originality and reliability of the scientific articles used in this study. Furthermore, it relates to the systematic quality of all identified publications to ensure that unique and credible sources are included in the SLR. This section is crucial in avoiding duplication, plagiarism, or previously reviewed material, thus ensuring the authenticity of the collected data. Furthermore, only articles that meet several QC are considered. A structured quality assessment (QA), as shown in Table 3, provides a quantitative measure of the overall quality of the research.

Table 3. QA criteria

Code	Assessment aspect	Description	Score (0–3)
QA1	Methodological	Clarity of research design and reproducibility	0=none, 3=strong
QA2	Dataset and validation	Use of real-world datasets or experimental validation	0=none, 3=strong
QA3	Technical contribution	Novelty and significance of results	0=none, 3=strong
QA4	Relevance	Direct contribution to IoT-based smart homes	0=none, 3=strong

2.2. Conducting

This section is crucial, as it outlines the QC for including results in the bibliography. The information data research articles are then processed within an information framework and compiled into a five-stage framework: first stage is collecting all original articles; second stage is exclusion and inclusion study based on title and abstract; third stage is exclusion and inclusion research based on the introduction and conclusion; fourth stage is exclusion and inclusion study based on full-text; and fifth stage is final selection for reporting full-text.

2.3. Reporting

For each included study, key metadata (author, year, publication venue, research domain, methodology, and contributions) were extracted into a structured database. The data were then synthesized into demographic analysis tables and figures to highlight trends in IoT utilization in the smart home context. The findings are reported in detail in the following sections.

2.3.1. Documenting the extraction result

This section is organized to analyze inventiveness and classify orderly writing SLR papers. This section is based on demographics from the SLR. The extraction results become a reference for the application of SLR and are attached in the next section.

3. RESULTS AND DISCUSSION

In the final stage, the author successfully obtained 2,256 articles that had been filtered up to the fifth-stage, as shown in Table 1. These results are a search for articles from 2019-2025. The initial articles obtained were 2,256 articles from the internet search. Several additional searches were conducted using a four-stage approach see Table 2, based on subsection 2.2 and the original data, as shown in Table 1.

3.1. Overview of selected studies

The author found that all systematic reviews shown in Tables 4-7 correlate with the purpose of this study. From an initial pool of 2,256 studies retrieved from seven leading digital databases (IEEE, ACM, ScienceDirect, Springer, MDPI, IAES, and Google Scholar), a number of peer-reviewed articles reviewed between 2019 and 2025 met all inclusion criteria. This reflects the increasing research attention on IoT integration in smart homes. Most of the studies originated from China, the United States, and Europe, indicating a concentration of research activity in regions with advanced IoT infrastructure. The method proposed in this study will likely have a higher proportion of knowledge than previous studies. The author succeeded in obtaining related research, with a total of 70 articles received by the provisions, see Table 4. This classification research paper is the chosen article for this SLR, see Table 5. The author started by searching for papers on the latest trends regarding the use of IoT in smart homes, as well as some related knowledge, which is presented in Table 6. After that, in subsection 2.3, the author searched based on country demographics from the 70 papers, as seen in Table 7. Displayed the demographics of each country; India and China get lots of scientific articles from the internet about the latest trends in IoT usage in smart homes, as shown in Table 7.

Table 4. The origin of the article

Database	Result
IEEE	567
MDPI	307
ACM	128
Springer	457
ScienceDirect	378
Hindawi	89
IAES	207
Google Scholar	123
Total	2,256

Table 5. Article selection

	1st stage	2nd stage	3rd stage	4th stage	5th stage
Data in Database	2,256	1,347	543	251	70

Table 6. The latest trend in IoT in smart home research (knowledge research)

Field Study	References	Number of papers
Artificial intelligence IoT	[12]–[20]	9
Assistant technology IoT	[3], [21]–[36]	17
BlockChain IoT	[37]–[42]	6
Energy-saving IoT	[43]–[48]	6
Enhance network IoT	[49]–[51]	3
Robot IoT	[52]–[61]	10
Security IoT	[62]–[68]	7
Privacy-preserving IoT	[69], [70]–[79]	11
Total		70

Table 7. Demographics of countries

Country	Number of publications
India	7
China	6
USA	5
Australia	7
Pakistan	5
UK	3
Italy	4
Malaysia	4
Spain	4
Indonesia	2
Greece	2
South Korea	3
Hongkong	1
Saudi Arabia	1
South Africa	1
Czech Republic	1
New Zealand	1
Portugal	2
Iraq	1
Kazakhstan	1
Nigeria	1
Romania	1
Bulgaria	1
Mexico	1
Russia	1
Slovakia	1
Denmark	1
Netherlands	1
Colombia	1
Total	70

3.2. Thematic trends and research maturity

According to SLR, IoT research for smart homes shows a shift from proof-of-concept prototype development (2019-2020) to AI-based automation and scale-up efforts (2022-2025). Growth,

interoperability challenges, privacy concerns, and the lack of a unified framework for multi-device ecosystems remain key barriers.

3.3. Research gaps and open challenges

This section will discuss the results of the existing review. Lack of longitudinal studies, limited real-world deployment data, or underrepresented user groups. Although topics such as AI, blockchain, and IoT security are not particularly new, relatively few papers have systematically connected these elements into an integrated system capable of simultaneously addressing real-time issues, user-based customization, and energy sustainability. Furthermore, SLR evidence indicates a paucity of cross-domain studies linking robotics and IoT in residential environments (10% of reviewed papers). This finding underscores the need to develop a framework for further innovation in smart home IoT.

3.4. Smart home overview

Several studies define a smart home as a residence with communication and information technology facilities. A smart home aims to enhance the user experience of its residents by integrating technology in managing and controlling various aspects of daily life [80]. However, the latest trend of using IoT to maximize smart homes involves several technologies, see Figure 2, such as AI, assistant technology, blockchain, IoT, energy-saving IoT, network IoT, robot IoT, and security IoT. The following section explains the benefits of each part, as shown in Figure 2.

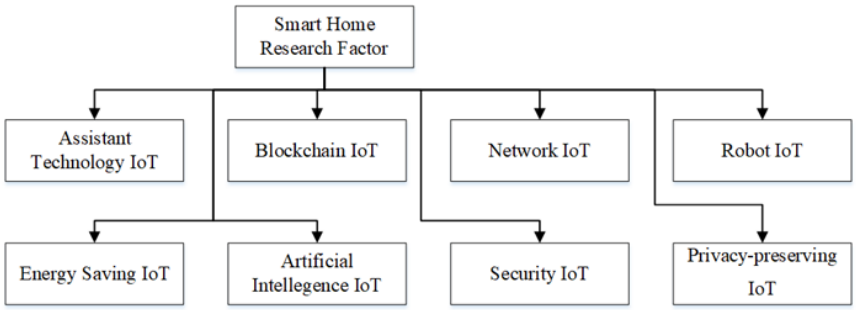

Figure 2. Distribution of IoT applications in smart homes by functionality

3.4.1. Artificial intelligence IoT

Smart homes are used for monitoring and through AI technology to maximize predictions. The synergy between AI and IoT is needed to manage electrical energy consumption. Artificial intelligence of things (AIoT) is a term for the combination of these two technologies, where IoT functions as data retrieval and automation technology, and then AI as decision-making [12]–[20].

3.4.2. Assistant technology IoT

The increasing human population challenges smart home service systems, especially the costs incurred. In minimizing these problems and providing assistant technology that can help efficiently, implementing IoT and assistant technology is very beneficial. This technology can potentially improve the quality of residential life while reducing the price burden on the service system. Even though IoT and technological assistance are very important, their use needs to be developed better [3], [21]–[36].

3.4.3. Blockchain IoT

Through the advancement of IoT, it is now widely used in residences, especially in smart homes, for practical and pervasive resource management. In a smart home, various sensors and IoT components are connected. This requires a centralized connection at the gateway. The role of gateways in smart homes is significant due to their centralized structure, which creates numerous security vulnerabilities. Therefore, to overcome this vulnerability, the smart home gateway network must be blockchain-based to minimize the possibility of attacks on the smart home gateway. The network consists of three layers, including device, gateway, and cloud layers [37]–[42].

3.4.4. Network IoT

The large number of IoT devices that utilize sensors can increase the possibility of devices being misused by unauthorized people. One of them is a distributed denial of service (DDoS) attack caused by the

weak security of IoT devices. When a DDoS attack occurs, the target is an attack on IoT devices in a smart home environment. Therefore, increasing network usage to help minimize DDoS attacks is very much needed [49]–[51].

3.4.5. Robot IoT

Robot technology that enables ubiquitous, long-term connectivity to power smart homes. In empowering universal smart home services, a robot maker is needed, an indoor robot equipped with advanced sensors from IoT. The robot can run in a joint optimization framework, combining measurements from sensor backscatter signals in estimating the robot's location for efficient use of the smart home [53]–[61].

3.4.6. Security IoT and privacy-preserving IoT

Smart home devices provide efficiency for residents and their surroundings, making them a good option. Home environment allows application developers, but there are problems with home security and privacy–preserving IoT. These problems typically include theft, burglary, privacy, and security issues with household devices. This can be solved with IoT and other security devices to provide convenience to users [62]–[79].

3.4.7. Energy-saving IoT

Smart homes here are also significant in supporting suitable housing, but in supporting clean energy and conservation, they still need to be used to save electricity. This is very important because energy savings are required for every country and even the world. There are many ways to make savings, such as using solar cells, wind turbines, or the efficiency of IoT devices themselves [43]–[48].

3.5. Interpreting results and limitations

This section will discuss the interpretation of the results of the understanding study. Our findings suggest that higher SLRs, conducted more recently, as shown in Tables 1-4, are not associated with poorer past performance. The proposed method may benefit researchers and industry professionals without negatively impacting others through SLR search. This study comprehensively investigates SLR searches and their results. However, additional and in-depth research may be needed to confirm the SLR results, especially regarding their application to IoT in smart homes.

4. CONCLUSION

This study presents an SLR on the development of IoT-based smart home technology (2019-2025). A total of 2,256 initial articles were identified from seven major databases (IEEE, ACM, ScienceDirect, Springer, MDPI, IAES, and Google Scholar), with 70 studies meeting the inclusion criteria and being thoroughly evaluated. The analysis describes that IoT-based smart home research continues to undergo significant evolution, from mere prototypes and basic concepts to the integration of artificial intelligence, blockchain, and robotics technologies for automation and security. However, key challenges such as inter-device interpretation, data security, and sustainable energy management remain significant obstacles. Furthermore, only about 10% of studies explicitly examine the integration of IoT and robotics in the context of everyday life, indicating a lack of holistic, cross-domain research. The results of this study highlight a crucial gap: the need for an integrated framework that combines security, energy management, and AI- and robotics-based automation to support a smarter, safer, and more sustainable smart home ecosystem. Further research is recommended to expand cross-disciplinary research that integrates IoT, AI, and robotics within a single innovation framework.

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Puji Prabowo		✓				✓	✓	✓	✓	✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to animal use has been conducted in accordance with all the relevant national regulations and institutional policies for the care and use of animals.

DATA AVAILABILITY

The result of the research is available on Mendeley at https://data.mendeley.com/datasets/snmbf9p627/1

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