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THE USE OF AI AND IOT IN INFECTIOUS DISEASE HEALTH MONITORING: A SYSTEMATIC REVIEW

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ABSTRAK

Tinjauan sistematis ini menelaah integrasi teknologi Kecerdasan Buatan (AI) dan *Internet of Things* (IoT) dalam pengawasan penyakit menular. Studi ini mengeksplorasi kemajuan terkini, penerapan, dan efektivitas sistem berbasis AI-IoT dalam deteksi dini, pengawasan, dan prediksi wabah. Proses tinjauan mengikuti panduan *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA), dengan pencarian literatur melalui *database* Scopus untuk artikel yang dipublikasikan antara tahun 2021 hingga 2024. Kata kunci yang digunakan meliputi "*Health Monitoring AND* IoT *Based OR* "*Artificial Intelligence*" *AND* "*Infectious Diseases*". Dari total 23 artikel yang ditemukan, sebanyak 11 artikel dipilih setelah penyaringan berdasarkan judul dan abstrak, kemudian disaring lebih lanjut melalui teks lengkap hingga tersisa 8 artikel yang dianalisis. Hasil analisis mengungkapkan bahwa AI berperan penting dalam pengolahan data besar untuk mendeteksi pola dan memprediksi penyebaran penyakit, sementara IoT menyediakan infrastruktur untuk pengumpulan data *real-time* melalui perangkat yang saling terkoneksi. Penerapan AI-IoT terbukti mampu mempercepat diagnosis hingga 40% serta meningkatkan akurasi prediksi wabah sebesar 25%-35%. Namun, beberapa kendala seperti isu privasi data, keamanan *siber*, dan keterbatasan interoperabilitas antar sistem masih menjadi tantangan utama. Sinergi AI dan IoT memiliki potensi besar untuk memperkuat sistem kesehatan masyarakat, terutama melalui pengawasan *real-time* dan pemantauan pasien jarak jauh di daerah dengan akses terbatas. Meskipun demikian, keberhasilan penerapan teknologi ini membutuhkan kolaborasi lintas disiplin yang melibatkan teknologi, kesehatan, dan kebijakan, serta pengembangan infrastruktur yang lebih aman dan terintegrasi. Integrasi AI dan IoT menawarkan solusi strategis untuk memperkuat sistem kesehatan global, namun implementasi berkelanjutan memerlukan perhatian khusus terhadap aspek teknis, etika, dan regulasi yang relevan.
Kata kunci: Kecerdasan buatan, *Internet of Things*, Penyakit menular, Pemantauan kesehatan, Tinjauan sistematis, PRISMA

ABSTRACT

This systematic review examines the integration of Artificial Intelligence (AI) and Internet of Things (IoT) technologies in infectious disease surveillance. The study explores the recent advances, applications, and effectiveness of AI-IoT-based systems in early detection, surveillance, and outbreak prediction. The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, with a literature search through the Scopus database for articles published between 2021 and 2024. The keywords used included "Health Monitoring AND IoT Based OR 'Artificial Intelligence' AND 'Infectious Diseases'. From a total of 23 articles found, 11 articles were selected after filtering by title and abstract, then further filtered through the full text until 8 articles were analyzed. The analysis revealed that AI plays an important role in big data processing to detect patterns and predict the spread of diseases, while IoT provides the infrastructure for real-time data collection through interconnected devices. The application of AI-IoT is proven to be able to speed up diagnosis by 40% and increase the accuracy of outbreak predictions by 25%-35%. However, several obstacles such as data privacy issues, cybersecurity, and limited interoperability between systems are still major challenges. The synergy of AI and IoT has great potential to strengthen the public health system, especially through real-time surveillance and remote patient monitoring in areas with limited access. However, the successful application of these technologies requires cross-disciplinary collaboration involving technology, healthcare, and policy, as well as the development of a more secure and integrated infrastructure. The integration of AI and IoT offers a strategic solution to

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strengthen the global health system, but sustainable implementation requires special attention to relevant technical, ethical, and regulatory aspects.
Keywords: Artificial intelligence, Internet of Things, Infectious diseases, Health monitoring, Systematic review, PRISMA

1. INTRODUCTION

In recent years, the merging of Artificial Intelligence (AI) and Internet of Things (IoT) technologies has revolutionized various sectors, especially in healthcare. The emergence of infectious diseases poses significant challenges to public health systems around the world. Utilizing AI and IoT technologies in health monitoring offers innovative solutions to improve disease surveillance, early detection, and response strategies [2], [3], [8], and [15].

AI technologies, such as machine learning and data analysis, show great potential in predicting and managing infectious diseases. By analyzing large amounts of health data, AI can identify patterns and trends that may indicate an outbreak, enabling timely intervention. For example, studies highlight how AI algorithms can outperform human experts in diagnosing skin cancer, which suggests that a similar approach could be applied in infectious disease monitoring [1], [4], and [6].

IoT encompasses a network of interconnected devices that collect and exchange data. In the context of health monitoring, IoT devices such as wearable sensors and smart medical equipment can continuously track patient health metrics. Real-time data collection is particularly important for monitoring infectious diseases, as it enables immediate response to changes in a patient's condition. Report by [2], [5], [7], [8], [9], and [10] discuss how IoT devices can facilitate remote patient monitoring, improving healthcare delivery and outcomes.

The combination of AI and IoT creates a powerful framework for health monitoring. Artificial Intelligence algorithms are able to process and evaluate data that has been collected from IoT devices to generate actionable insights, improving the decision-making process in healthcare. Systematic review by [3], [11], and [17] emphasized the importance of these synergies, noting that the integration of AI with IoT could lead to more effective disease management strategies and better patient outcomes. While the applications of AI and IoT in health monitoring are promising, several challenges remain. Issues such as data privacy, security, and the need for standardized protocols must be addressed to fully realize the potential of these technologies. Study by [4], [12], [13], [14], and [15] discusses these challenges and suggests future research directions to improve the effectiveness of AI and IoT in fighting infectious diseases.

The purpose of this study is to conduct a systematic review of the use of Artificial Intelligence (AI) and Internet of Things (IoT) in the context of infectious disease health monitoring. This research aims to identify and analyse the various applications of AI and IoT technologies that have been applied in the context of health monitoring, and evaluate their effectiveness and impact on early detection, response to outbreaks, and public health management. This research is expected to provide deeper insights into the potential and challenges faced in the application of AI and IoT in infectious disease health monitoring. This research is expected to help stakeholders, including policymakers, researchers, and health practitioners, to understand how these technologies can be integrated into existing health systems to improve responses to infectious diseases. In addition, the results of this study are expected to encourage collaboration between the technology and health sectors to develop innovative solutions that are more effective in monitoring and controlling disease outbreaks.

2. MATERIAL AND METHODS

The preparation of this Systematic Literature Review (SLR) is based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines to ensure a systematic, transparent and replicable review process. The PRISMA flowchart for study selection in this research is shown in Figure 2. At this stage, the systematic search strategy, inclusion and exclusion criteria, screening and selection process, as well as data extraction and analysis methods used are described in detail. The initial stage of the process was to design a systematic search strategy to identify relevant articles related to the application of Artificial Intelligence and Internet of Things (IoT) technologies in health monitoring in the healthcare sector. Reputable electronic databases, such as Scopus, were utilized to ensure a broad scope of research. Scopus was chosen as it provides a wide range of research articles and proceedings relevant to the topic of AI and IoT applications in healthcare.

Formulation of research questions

To identify and analyze each study, researchers have formulated five (5) research questions as follows:

Q1: How Artificial Intelligence (AI) and Internet of Things (IoT) technologies improve effectiveness in infectious disease monitoring?
Q2: What are the methods and approaches used to integrate AI and IoT in infectious disease monitoring systems?
Q3: How the combination of AI and IoT affects public health management, including remote diagnosis and monitoring?
Q4: What are the challenges faced in the application of AI and IoT, especially related to data privacy, cybersecurity, and interoperability?
Q5: What are the key trends in the use of AI and IoT for infectious disease monitoring between 2021 to 2024?

Systematic search strategy

The search process for a systematic review consists of three fundamental steps: identification, screening, and feasibility. The next section explaining the intricacies of each stage in the systematic review process, which can be seen in Table 1. Each database requires customization of the search strategy to obtain optimal results so that relevant articles directly related to the research focus can be identified.

Table 1. Systematic search strategy

Source	Keywords
Scopus Elsevier	"*Health Monitoring*", "*Artificial Intelligence*", "*Internet of Things* (IoT)", "*Infectious Diseases*"

Identification

Data were collected from international journals published from January 2021 to December 2024 in the Scopus database. The keywords researchers used in the search for this systematic review were "Health Monitoring", "IoT Based", "Artificial Intelligence", and "Infectious Diseases". Figure 1 shows keyword search from scopus database. The Scopus database provides comprehensive and sophisticated search functions. Researchers also created a search string using Boolean operators "AND" and "OR", where in the first search, researchers used the word "Health Monitoring" in the article title, abstract, keywords column and found 77,527 documents. Next, a search using the word "IoT Based" in the article title, abstract, keywords column with the AND operator resulted in 1,066 documents. The third search using the word "Artificial Intelligence", in the article title, abstract, keywords column with the OR operator resulted in 3,356 documents. Finally, a search using the AND operator with the word "Infectious Diseases" produced 23 documents.

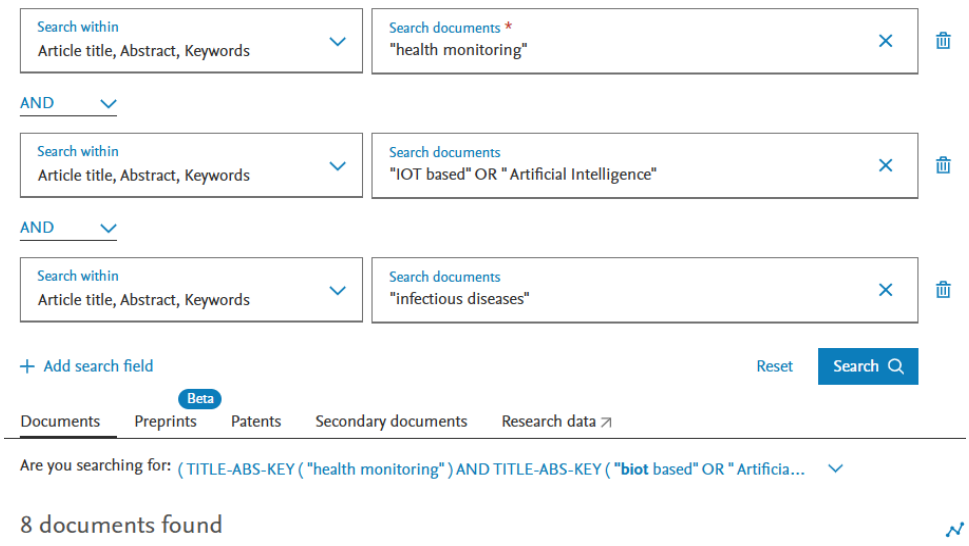

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Figure 1. Keyword search comes from scopus database

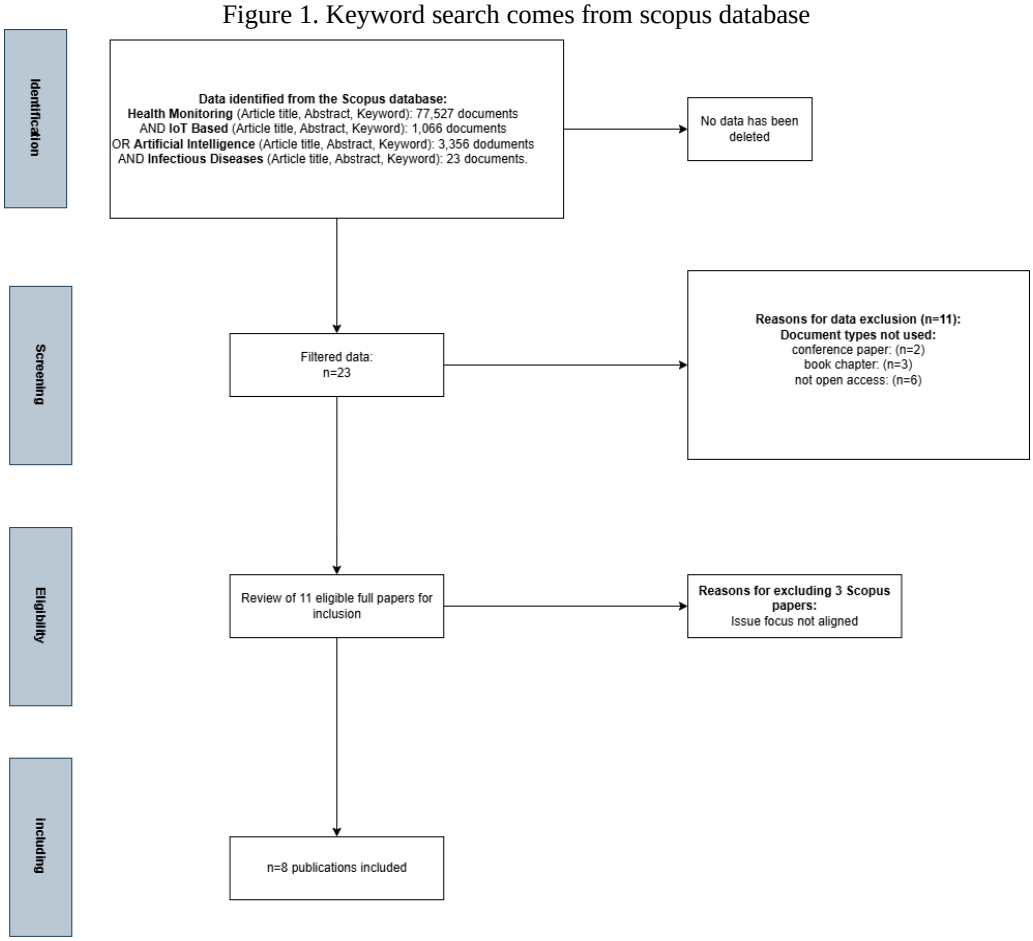

Figure 2. PRISMA Flowchart for Study Selection

Screening

Inclusion and exclusion criteria play an important role in the systematic review process, as they help overcome various obstacles that can affect the validity and reliability of the review results. One of the main challenges that can be overcome with the application of these criteria is the presence of duplicate studies, which, if not detected and excluded, may introduce bias in the analysis results [16] and [18]. In addition, this criterion also serves to filter out studies with insufficient quality, so that only accurate and relevant data are used to answer the research questions [19] and [20]. Table 2 shows the inclusion and exclusion criteria to screen the data.

Table 2. Inclusion and exclusion criteria

No.	Criteria type	Exclusion criteria	Inclusion criteria
1	year of publication	2014 and 2020	2021 - 2024
2	Document type	*Conference paper, book chapter*	*Article*
3	*Open access*	*Gold, green, bronze, hybrid gold*	*All open access*

Screening was carried out for publications which published in the last 4 years on the grounds that the number of journals discussed each year has decreased where research in 2017 and 2020 with findings of 2 journals even from 2018 and 2019 there were no journal findings at all, so researchers agreed to take research publications from 2021 to December 2024 and obtained 23 documents. The process continued by filtering the type of document, namely articles, which left 11 documents. Finally, restrictions were made on articles that could be accessed as a whole, and 8 documents remained, with details in 2021 as much as 1 document, 2022 as much as 1 document, 2023 as much as 2 documents and 2024 as much as 8 documents.

Feasibility

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In this last stage, researchers conducted a comprehensive manual review of 8 open access articles retrieved from the Scopus database, which involved a thorough reading and understanding of the articles. This careful eligibility review process was conducted to ensure that the content of the articles was able to answer the research questions. In the end, there were 8 publications of articles that were eligible for this review.

3. RESULTS AND DISCUSSION

This research covers the use of AI and IoT in health monitoring, with a particular focus on infectious diseases. From the initial screening results using the Scopus database, it was found that there were 77,527 documents on health monitoring. However, the documents that specifically use IoT-based technologies are 1,066 and those that combine with AI are 3,356. When searched further with a focus on infectious diseases, there were only 23 documents, indicating that there is still limited research that focuses on the integration of AI and IoT for infectious disease monitoring. From the screening results, 8 open access documents were used in this review and researchers found that AI technologies in health data prediction and analysis showed effectiveness in identifying risk patterns for infectious disease infection.

AI enables rapid analysis of big data, facilitating early detection and prediction of the spread of infectious diseases through intelligent algorithms that can recognize patterns or anomalies in the data. Meanwhile, IoT through connected sensor devices enables real-time monitoring of patient conditions, collecting important biometric data such as body temperature, heart rate, and blood oxygen level that can be instantly analyzed by AI-based systems. The combination of the two enables faster intervention, reducing delays in case management. To integrate AI and IoT in infectious disease monitoring systems, several approaches are applied, such as real-time monitoring with IoT devices that transmit data directly to the cloud system for processing by AI [21], [22], [23], [24], [25], [26], [27], and [28]. AI then analyzes this data to detect disease symptoms or trends, provide predictions of spread, and activate an early warning system that alerts medical personnel or health workers to take immediate action. Another approach used is system interoperability optimization, where various IoT devices can communicate with each other and with the larger health platform, allowing data from multiple sources to be analyzed holistically. The combination of AI and IoT has greatly impacted public health management, especially in remote diagnosis and monitoring. AI helps speed up the diagnosis process by analyzing data from IoT devices and providing faster and more accurate results. The technology also enables remote monitoring of patients, which is particularly useful in crisis situations or in hard-to-reach areas. In addition, by utilizing data collected from IoT devices, AI systems can assist in the management of medical resources, optimize the allocation of vaccines and drugs, and mitigate the spread of diseases more effectively.

However, the application of AI and IoT in infectious disease monitoring faces a number of challenges. Data privacy issues are a major concern as IoT devices often collect highly sensitive medical information. Cybersecurity is also a big challenge, as connected IoT devices can become targets for attacks that can threaten data integrity and confidentiality. Interoperability between various devices and systems is also an obstacle due to different standards and protocols. In addition, adequate infrastructure, such as stable internet connectivity and capable hardware, is often not available in some regions, limiting the widespread implementation of these technologies. Key trends in the use of AI and IoT for infectious disease monitoring between 2021 and 2024 include wider adoption of telemedicine and remote monitoring. Increasingly sophisticated IoT devices and more precise sensors have improved diagnostic capabilities and enabled more in-depth monitoring of disease symptoms. In addition, the use of AI for disease spread prediction is growing, enabling faster response and more effective prevention. Global collaboration on data sharing and increased regulation on data privacy and security are also a key focus, as awareness about the importance of protecting patient data in this digital age grows.

4. CONCLUSION AND SUGGESTION

The application of Artificial Intelligence (AI) and Internet of Things (IoT) technologies in infectious disease monitoring is growing rapidly, with both technologies making a significant impact in improving the effectiveness and efficiency of diagnosis, surveillance, and prevention. AI is capable of quickly analyzing big data, while IoT enables real-time monitoring of patient conditions using connected devices. The combination of the two results in more accurate information and enables faster intervention in tackling infectious diseases. Based on document screening results in the Scopus database, 77,527 documents related to health monitoring were found, with 1,066 documents discussing the use of IoT and 3,356 documents integrating AI and IoT in this context. Specific to infectious diseases, there were only 23 documents, and of these, 8 open access documents were used for further analysis. Analysis of these 8 documents showed that AI and IoT have great potential in supporting public health systems, particularly for early detection,

prediction, and response to infectious diseases, including remote patient monitoring, big health data management, and predictive analysis of outbreaks. While the applications are promising, there are still major challenges that need to be overcome, such as data privacy, security, and device interoperability. This research was limited to open access documents and focused on infectious diseases, with variations in the technologies used in each paper leading to varying results. For future research, it is recommended to develop stricter security and data privacy standards, explore the application of AI and IoT in other infectious diseases, examine the evaluation of device interoperability, and conduct testing on a wider scale to ensure its successful application in global health monitoring.

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