Exploring the Impact of IoT on Library Collection Management Efficiency: A Literature Review

Damar Nur Satria Pamungkas[1], Zulfatun Sofiyani[1], Huda Hamidon[2], Noor Arina Md Arifin[2], Normashidayu Abu Bakar[2]

[1]*Faculty of Social and Political Science, Universias Airlangga, 60286 Surabaya, East Java, Indonesia*
[2]*Information Science Studies, College of Computing, Informatics and Mathematics, Universiti Teknologi MARA Cawangan Kelantan,18500 Machang, Kelantan, Malaysia*

Corresponding author's e-mail address: damar.nur.satria-2022@fisip.unair@gmail.com

ARTICLE INFO	ABSTRACT
	The emergence of the Internet of Things (IoT) has brought massive changes in various sectors, particularly in library collection management. This paper discusses the impact of IoT on enhancing the efficiency of library collection management practices. By integrating IoT technologies such as Radio Frequency Identification (RFID), smart sensors, and cloud computing, libraries can achieve greater operational efficiency, better accessibility, and stronger security. These technologies facilitate real-time data collection and analysis, streamline inventory management, and automate circulation processes, resulting in increased user engagement and higher service quality. However, implementing IoT comes with challenges, including the need for large investments in security, staff training, and technology infrastructure. This review aims to provide a comprehensive analysis of the benefits and challenges associated with IoT integration in libraries, with a special focus on Indonesian libraries. Research findings indicate that while IoT offers significant advantages in modernizing library services, careful planning and resource allocation are essential to overcome the associated barriers. Future research directions are proposed to further explore the potential of IoT in transforming library operations and enhancing service delivery.

INTRODUCTION

The increasing need to enhance service quality and efficiency, combined with technological advancements, has led to an increase in the deployment of the Internet of Things (IoT) in libraries. As libraries adjust to the demands of the digital age, integrating IoT technologies offers revolutionary potential to improve user experience and operational efficiency, significantly impacting collection management by providing a multitude of advantages, including enhanced accessibility, strengthened security, and improved efficiency through easier real-time data collection and analysis, enhanced inventory control using Radio

Frequency Identification (RFID) technology and smart sensors, and automated check-in and check-out procedures (Shashidhara, 2023). Despite its benefits, the implementation of IoT also presents challenges, including the need to invest in security measures, train staff, manage costs, and foster a culture of technological adaptation (Panigrahi et al., 2022). In the context of collection management efficiency, libraries can use IoT to enhance user engagement and operational efficiency through asset tracking, environment monitoring, and user behavior analysis. These improvements can result in better air quality, less material loss, and personalized services. However, it is important to consider data management and security issues. (Prasad & Jahnavi, 2019).

IoT has a huge and diverse impact on library collection management, posing both benefits and challenges. As libraries strive to enhance the integrity of their services and adjust to the digital era, the incorporation of IoT technology offers prospects to revolutionize the management and accessibility of collections. One of the significant IoT applications is the use of RFID technology for book data management, borrowing and returning books (Pramono et al., 2020). Libraries also can offer more adaptable and user-responsive services by leveraging cloud computing and cutting-edge technology (Saptari, 2023). Besides, libraries might improve user engagement in literacy programs and facilitate quicker and simpler access to their collections by using technology like web-based applications and integrated information systems (Ferizal et al., 2021).

Integrating the IoT into library collections not only improves operational efficiency but also significantly enhances user access to materials and overall accessibility for library users. Apart from enhancing efficiency, IoT also helps to enhance user experience. Users can make reservations, obtain applications collection information online, and receive interest-based book suggestions by utilizing IoT-based (Adirati, 2023). However, challenges in information system integration remain a critical concern. To successfully integrate IoT technologies, libraries must be equipped with the necessary infrastructure and devices to support these applications, including reliable internet connectivity (Adirati, 2023).

The utilization of IoT in Indonesia libraries for collection management presents a significant opportunity to enhance productivity and elevate the quality of services. The IoT enables libraries to incorporate a range of cutting-edge technologies, including sensors, RFID and cloud-based management systems, which can improve user experience and optimize collection management. For instance, libraries that have already adopted smart library systems can use QR codes to access book information and other library services quickly and efficiently (Simalango & Naim Mursalim, 2019). The use of QR code can make it easier for the users to access information they need without having to go through a time-consuming manual process.

The primary objective of this literature review is to ascertain how IoT can enhance the most effective collection management practices used by libraries. As libraries increasingly integrate IoT technology, it becomes essential to understand how these advancements might improve user engagement, resource allocation, and operational efficiency. This review aims to summarize the literature to provide a comprehensive understanding of the benefits and challenges associated with IoT integration in libraries.

RESEARCH QUESTIONS

To guide this study, the following research questions have been formulated:

1. RQ 1. How do IoT technologies influence the efficiency of collection management in libraries?

2. RQ 2. What benefits and challenges do libraries face when integrating IoT technologies into their collection management systems?

3. RQ 3. How is implementation of IoT technologies in library's collection management efficient in Indonesian libraries?

LITERATURE REVIEW

Internet of Things

The Internet of Things (IoT) is a revolutionary force in the digital age that is drastically altering how systems and objects interact, thanks to its seamless connectivity. According to Technopedia, in Pujar and Satyanarayana (2015), the "Internet of Things" is a technological concept that describes a future when commonplace physical objects will be able to interact with one another and identify themselves to other devices over the Internet. Kevin Ashton first introduced the concept of IoT in 1999 as a network of connected devices that can talk to each other over the Internet, such as computers, sensors, and other common items that have evolved until now (Panigrahi et al., 2022). In 2005, the United Nations' International Telecommunication Union (ITU) released a report that helped popularize the phrase, marking a major turning point in public knowledge and understanding of the IoT (Chin et al., 2019). The IoT consists of various components, such as sensors, communication, data processing, user interfaces, energy management, cloud computing, and others, which work as an interconnected ecosystem (Pujar & Satyanarayana, 2015). Until now, IoT has revolutionized several areas, such as smart cities, healthcare, and many others, including libraries (Panigrahi et al., 2022).

Library

Libraries have always been a part of human civilization and are vital components of research and educational organizations. They facilitate the accomplishment of academic, scientific, and student objectives in both teaching and research (Safdar et al., 2023). A library is an institution that collects, processes, maintains, and disseminates recorded information in a format appropriate to its target audience (Onoyeyan & Adesina, 2014). According to Safdar et al. (2023), libraries offer a multitude of services, from preservation to data, information, and knowledge access. Its involvement in research and collection management activities at libraries highlights its significance in the knowledge-based economy. As information technology has advanced, libraries have greatly expanded their facilities and enhanced both the quality and efficiency of their services (Zareef & Ahmad, 2021). These developments can greatly improve user experience and ultimately contribute to the advancement of knowledge across various disciplines.

Collection Management

The methodical process of gathering, arranging, preserving, and granting access to materials inside a library or information center is known as collection management. It includes a variety of actions meant to guarantee that the collection satisfies user needs while abiding by institutional objectives and financial limitations. The primary purpose of collections management is to ensure that library resources are available in an adequate and efficient manner and that they are consistent with the mission of the institution and the needs of users. Collection management in the digital age has changed dramatically with advances in information technologies that have transformed traditional libraries into digital repositories that are more user-friendly and easier to access digital content (Rahmani, 2022). According to Rahmani (2022), the administration of library collections must encompass more than just digital resources while it also entails the best possible execution of library operations and advancement toward organizational objectives.

METHODOLOGY

Source of Questionnaire

The methodology used in this paper is literature review. This paper relies on an analytical approach based on the available literature on the IoT and its components as applied to library services. A literature review assesses the existing research on a particular academic topic, concept, or issue. The objectives are finding knowledge gaps and suggesting a course of action for further research (Chigbu et al., 2023). According to Xiao and Watson (2019) there are eight steps involved in doing a thorough literature review stated in Figure 1 that consist of defining and analyzing the problem, searching, screening, checking, extracting, and analyzing data, and the last is reporting (Yeasmin, 2024).
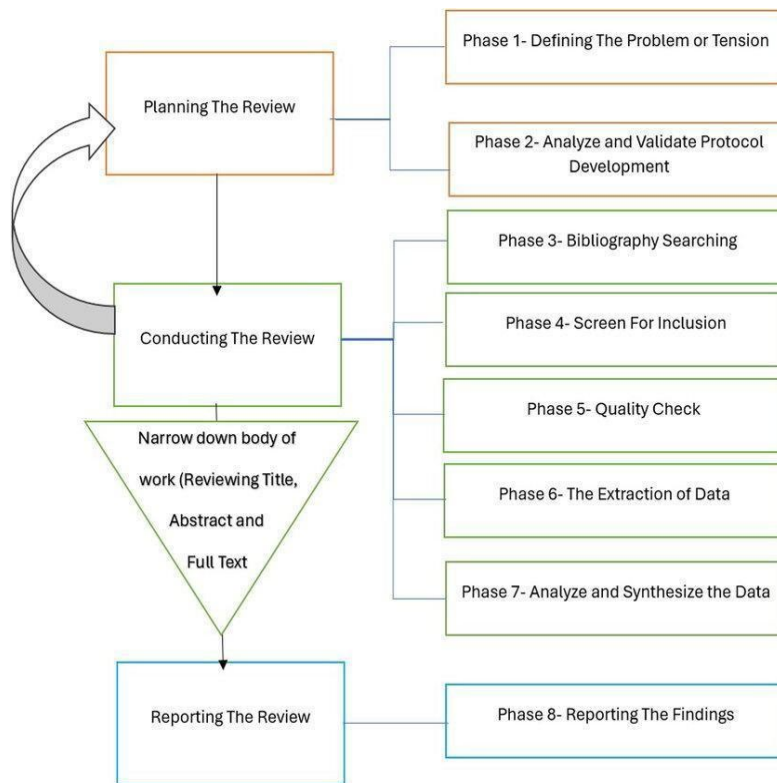

Figure 1. Steps for Conducting a Literature Review (Xiao & Watson, 2019)

DATA COLLECTION

The scope of this literature review encompasses a wide range of studies focusing on the application of IoT within libraries, specifically targeting collection management practices in Indonesia's library that includes studies and discussions published within range 2014 until 2024. By examining various IoT technologies and their implications for library efficiency, this review seeks to identify key themes and trends that emerge from the literature. Additionally, it will highlight gaps in current research and propose future directions for investigation, ultimately contributing to a deeper understanding of how IoT can transform library practices and enhance service delivery.

STUDY FINDINGS

This study compiles the information gathered by providing eight publications. The chosen studies concentrate on various Internet of Things applications, each providing a distinct viewpoint on the evolution of library services. Table 1 shows the analysis of the findings based on themes.

Table 1. Study Findings

Themes	Findings	Authors
Influence of IoT technologies on the collection management efficiency in libraries	• IoT technologies are essential to modernizing library collection management, especially when it comes to RFID technology. • IoT has accelerated the shift in library services from traditional to online forms, highlighting the necessity of innovation and the provision of digital services. • IoT technologies, through process automation, accuracy enhancement, and user experience improvement, have transformed the management of library collections.	Adirati (2023); Ayuningtyas (2022); Pramono et al. (2020); Sinha and Brar (2022)
Benefits and challenges of integrating IoT technologies into library collection management systems	• IoT integration with RFID or QR codes in library lockers increases user experience, saves time, boosts management effectiveness, and assures security. • Many advantages come from incorporating IoT technology into library collection management systems, such as increased automation, effective inventory control, better user access, less human work, more security, and future-proofing library services. • Integrating IoT enables libraries to remain up-to-date of technological breakthroughs as they change in the digital era. By providing up-to-date services, this not only modernizes library operations but also draws in additional patrons. • Even though there are many advantages by integrating IoT technology with library collection management systems, but there are also a number of issues that must be resolved for the deployment to be effective such as technology maintenance, staff training, dependence on technology, also data protection. • It might be technically challenging to integrate IoT technology like RFID into library systems. • IoT systems need to be flexible enough to grow with libraries and change with technology. Careful planning and investment in technology that can be expanded or upgraded without causing major disruptions are necessary for this.	Anggrowati and Maryatun (2024); Adirati (2023); Ayuningtyas (2022); Pramono et al. (2020); Wardihani et al. (2021)
Example of IoT technologies integration in library's collection	• IoT is transforming user experiences and reinventing library services. Smart solutions for asset control, location-based services, library management, and recommendation services are made possible by IoT. For example, is the development of IR Labschool Cibubur	Komarudin et al. (2024); Wardihani et al. (2021); Anggrowati and Maryatun (2024);

management efficiency	• An IoT-based Library Management System (LMS) has been implemented at the SDN Kramas, Semarang library. Students and librarians can use the library system remotely thanks to the LMS. • An example of an IoT application is the Integrated Library Information System at the Universitas Gadjah Mada (UGM) Library. Through the integration of many library tasks, including collection processing, circulation services, and membership management, this system improves the effectiveness of library operations by supporting cross-unit services and interlibrary loans. • QR codes are used by the Batam smart library design as part of its IoT connection. Another instance of IoT integration in Batam's libraries is the usage of Radio Frequency Identification (RFID). Web services and Internet of Things technologies are also integrated to assist the Open Access (OA) program, which is essential for sharing academic resources amongst Batam's many universities. Furthermore, Smartphones serve as a vital interface for communicating with the system of smart libraries in Batam.	Simalongo and Naim Mursalim (2019)

DISCUSSION

IoT Technologies in Library Collection Management

The incorporation of IoT technologies into the management of library collections has become a game-changing strategy that improves service delivery, user engagement, and operational efficiency. One of the primary applications of IoT in libraries is utilizing RFID technology for distribution and inventory management. Compared to traditional barcodes, RFID technology is more advanced. RFID can be used to track and manage library collections more effectively (Ayuningtyas, 2022). RFID tags, which can be frequently connected to books, allow for easy tracking and inventory control, lowering the effort and time required for manual cataloging and inventory check. As a security measure, it assists in identifying books that are taken out of the library without following the correct borrowing processes (Pramono et al., 2020). Among the several important uses of RFID in libraries is the ability to facilitate self-service book returns and loans. With the help of librarians, users can check out books on their own because security gates can read the RFID tags on the books (Adirati, 2023). Moreover, this method facilitates book returns via book drop boxes, increasing user convenience and lowering the requirement for direct staff participation.

IoT also facilitates the development of smart libraries, which leverage interconnected gadgets and sensors to automate processes, monitor assets, and provide personalized services to customers. According to Ayuningtyas (2022), smart libraries use digital platforms and cloud computing to safeguard and administer digital materials such as e-books and journals. A special focus is placed on cloud computing, one of the technologies that has allowed libraries to survive in the digital age (Sinha & Brar, 2022). It supported IoT integration by offering the data processing and storage architecture required to manage the massive amounts of data generated by IoT devices in libraries. Through the integration of cloud computing, users can access distant library resources, which enhances the user experience and allows circulation services to be done via the web or digital library application.

Furthermore, the use of IoT technologies streamlines the growth for user involvement that improves the entire library experience. IoT in libraries can offer the potential to improve operational efficiency through enhanced data analytics. Libraries can use IoT devices to gather data about how their resources are being used (Adirati, 2023). The data collected by IoT devices helps libraries achieve broader goals, such as improving the efficiency of their services and supporting educational initiatives (Ayuningtyas, 2022). By understanding how resources are used, libraries can adapt their offerings to better serve their communities and contribute to learning and growth. Through this information, they can gain valuable insights into user behavior and preferences that help them make smarter decisions about expanding and managing their collections, ensuring that they're offering the materials and services that best meet the needs of their community.

Benefits and Challenges of IoT in Library Collection Management

Integrating IoT technologies into library collection management offers many benefits, improving how well and smoothly library services operate. This allows libraries to streamline how they track and manage resources, making it easier to understand what users need and prefer. This can lead to better decision-making, better access to materials, and a more personalized experience for library visitors. For example, IoT devices, such as RFID tags, enable real-time tracking of books and other materials (Anggorowati & Maryatun, 2024). Based on Purnomo et al. (2020), the use of IoT also enables real-time data management and transfer. This allows library staff to update data of the information and location of books through the internet, which helps maintain accurate collections inventory.

Additionally, IoT makes it easier to automate circulation processes, such as borrowing and returning books (Ayuningtyas, 2022). Users can book the collections, also borrow and return it through online or mobile applications, managed by the digital platform. This simplifies the process and provides up-to-date information on the status of library materials. IoT-enabled systems also can send notifications to users about overdue items, upcoming deadlines, and the availability of ordered materials (Anggorowati & Maryatun, 2024). This proactive communication encourages timely returns and increases customer satisfaction, as well as improving the flow of circulation in the library.

Moreover, by the use of IoT, libraries have adopted a hybrid service model in this digital era, so the libraries can provide both physical and digital collections. This approach ensures that users, whether visiting the library in person or accessing materials online, can use its resources in a way that best suits their needs and preferences (Adirati, 2023). It showed that IoT has played an important role in Society 5.0, acting as a network that connects various systems and devices, such as the development of digital libraries. Society 5.0 aims to reduce human inequality through technology, with digital libraries helping to bridge knowledge gaps and encouraging intellectual growth among different segments of society by providing broad access to information (Ayuningtyas, 2022). Ayuningtyas (2022) explained that as Society 5.0 seeks to create a "super smart" society, digital libraries encourage lifelong learning by offering a wide range of learning resources and tools that can be accessed anytime, anywhere. This encourages continuing education and skill development.

However, implementing IoT technology comes with its own challenges. First of all, integrating IoT into the library system requires careful planning and execution. Pramono et al. (2020) emphasized the need for certain hardware and software configurations, for example NodeMCUs and RFID devices, which can be difficult to set up and manage. Adopting an IoT system also requires regular maintenance to ensure it is functioning properly (Anggorowati & Maryatun, 2024). This might include ensuring network connectivity, repairing hardware, and updating software, which can consume a lot of resources. Besides, libraries should consider the costs of acquiring, installing, and maintaining an IoT system, as these costs may be too high for some institutions.

Furthermore, as part of the transition to IoT-based systems, library staff must be trained to effectively manage and operate the new technology. Not only that, continuous training is also essential as technology advances, to ensure employees are always up-to-date on the latest innovations and features of IoT systems (Anggorowati & Maryatun, 2024). Providing ongoing support and resources to library staff is also critical to helping them adapt to new systems and overcome any challenges they may face (Wardihani et al., 2021). This support may include additional training sessions, technical assistance, and access to tools for lifelong learning.

Anggorowati and Maryatun (2024) also stated that the implementation of IoT technology in libraries raises significant concerns about technology dependence and data protection. Integrating IoT systems into library operations might increase library reliance on technology. This dependency means that any error or technical glitch can significantly impact the management and efficiency of library services. That means libraries should develop robust technical support and maintenance policies, including contingency plans, to minimize the risks associated with technology dependencies and successfully address potential system failures or downtime. Additionally, with the introduction of IoT in libraries, robust data protection measures have become more important than ever. Ensuring compliance with data protection regulations and implementing secure data management practices are important steps in protecting user privacy and maintaining trust in library technology systems.

Implementation of IoT in Indonesian Libraries

The use of IoT technologies in library collection management has significantly increased user engagement and operational efficiency in Indonesia. IoT has transformed traditional library services by transforming them into smart or digital libraries that will continue to evolve with the times. One example of implementing IoT in a school environment is the Institutional Repository (IR) Labschool Cibubur (Komarudin et al., 2024). By enabling easy access to digital resources, IoT provides easy-to-use services to support academic activities, especially when offline services are disrupted, as seen during the pandemic. The development of IR Labschool Cibubur is in line with the enhancement of the Learning Management System (LMS), which provides advanced opportunities for learning environments through the best use of IoT. The use of IR Labschool Cibubur makes it easier for users to manage, connect, and access gray literature and other digital resources. This connection allows users to access collections without being limited by traditional library service hours. By providing seamless access to a wide range of materials, it fosters ongoing academic activity and keeps pace with technological advances and current educational needs.

The same goes for the integration of IoT technology into library collection management at SDN Kramas, Semarang which has significantly increased in efficiency and accessibility, enabling libraries and users to manage and use library resources more effectively (Wardihani et al., 2021). The aim of this system is to improve connectivity and access to library resources through sustainable internet connectivity. IoT-based systems enable effective management of library collections by integrating functions for processing book information, such as accessing, editing, and updating details such as ISBN, title, category, authors, publishers, and more. These comprehensive management features ensure that the library collection remains current and easy to navigate. Furthermore, this library system also supports remote access that allows users in different locations to interact with library materials. This feature improves the overall user experience and operational efficiency, particularly when managing user accounts and passwords.

In the context of higher education or university, The UGM (Universitas Gadjah Mada) Library applies IoT technology through a network system, focused on real-time asset tracking, and the concept of a smart library, aiming to increase efficiency in collection management (Anggorowati & Maryatun, 2024). The UGM Library uses an automation integrated library information system called SIPUS (Sistem Informasi Perpustakaan) that offers cross-unit services such as inter-library loans which is connected across different

faculties and units within UGM also other university systems, making it possible to manage library collections and services effectively. Moreover, as a library system, SIPUS included standard features such as membership management, integrated cataloging, collections processing, circulation services and system management. Additionally, UGM also developed another library system called "Gadjah Mada Knowledge Hub" that is a smart library infrastructure combined with integrated technologies, such as UGM Repository and I-Library, which enhance collection management efficiency and facilitate access to digital materials.

In one of the cities in Kepulauan Riau, Batam, smart library architecture integrates IoT technology through QR codes, enabling efficient management of library collections by allowing users to quickly access digital resources and information about physical books, simplifying the process of finding and managing materials (Simalango & Naim Mursalim, 2019). A key element in automating the collection management of the Batam library is the use of IoT and mobile RFID technology, which enables real-time tracking of resources, reduces manual errors, and increases efficiency of the book check-in and check-out process, leading to improved overall management. Web services are required to incorporate IoT technology into the Batam library system because they enable seamless interaction across systems regardless of platform or programming language, which is critical for managing collections across many libraries. The integration of IoT technologies also supports the Open Access (OA) movement by allowing libraries to manage and share collections effectively, which is crucial for distributing academic materials between universities in Batam. This encourages accessibility and collaboration between academic institutions

LIMITATIONS AND RECOMMENDATIONS

This study provides important insights into the use of IoT technology in managing Indonesian library collections. However, it is important to acknowledge some limitations and offer recommendations for further research. One of the main limitations of this study is its scope, which mainly focuses on specific case studies from different regions in Indonesia. While these cases demonstrate the potential benefits of IoT integration, more research is needed to assess the broader adoption and impact of this technology in public libraries across the country. A more comprehensive study, including a larger sample size and different library environments, would provide a more complete understanding of the challenges, best practices, and long-term impacts of the implementation of IoT. In addition, this research did not delve deeply into the resources and finance required for successful IoT integration. A deeper analysis of the cost-benefit aspects, funding sources, and resource allocation strategies used by libraries is critical to understanding the feasibility and sustainability of these technology initiatives.

Future research could examine how users perceive and engage with IoT-enabled library services. Understanding end-user perspectives including their satisfaction, ease of use, and overall engagement can help in designing more user-centric IoT solutions for libraries. Lastly, this research mainly focuses on the operational and service aspects related to IoT integration. A more comprehensive understanding of the transformational impact of IoT on the library environment can be achieved by expanding research to examine wider implications, such as its impact on the roles, skills and training needs of library staff, as well as ethical considerations around data privacy and security.

CONCLUSION

In conclusion, the integration of IoT technology into library collection management has shown great potential to increase operational efficiency, improve accessibility, and improve user experience, especially within Indonesia context. The case study highlights the effectiveness of IoT-based systems in enhancing various library functions, such as real-time asset tracking and seamless user interactions. However, to take full advantage of these benefits, further research is necessary to assess the national adoption and long-term

impact of this technology. This research should address the financial and resource challenges of IoT implementation, as well as consider the perspectives and experiences of library users. In addition, it is important to assess the broader implications for library staff, including changes in their roles, required skills, and training needs. By addressing these important factors, libraries can create more sustainable, user-centric IoT solutions that maximize the benefits of technology integration, adapt to the changing needs of their communities, and ultimately improve the overall experience for users and staff.

ACKNOWLEDGEMENT

REFERENCES

Adirati, M. (2023). Tren Layanan Perpustakaan Saat dan Pasca Pandemi Covid-19. *Media Informasi*, *32*(1), 15–27. https://doi.org/10.22146/mi.v32i1.6243

Anggorowati, D. N., & Maryatun. (2024). *Penerapan Teknologi Internet of Things di Perpustakaan Universitas Gadjah Mada*. *33*(1), 1–8.

Ayuningtyas, A. A. (2022). Penerapan Internet of things (IoT) dalam Upaya Mewujudkan Perpustakaan Digital di Era Society 5.0. *Jurnal Ilmu Perpustakaan*, *11*(1), 29–36. https://ejournal3.undip.ac.id/index.php/jip/article/view/40244

Chigbu, U. E., Atiku, S. O., & Du Plessis, C. C. (2023). The Science of Literature Reviews: Searching, Identifying, Selecting, and Synthesising. *Publications*, *11*(1). https://doi.org/10.3390/publications11010002

Chin, J., Callaghan, V., & Ben Allouch, S. (2019). The Internet-of-Things: Reflections on the past, present and future from a user-centered and smart environment perspective. *Journal of Ambient Intelligence and Smart Environments*, *11*(1), 45–69. https://doi.org/10.3233/AIS-180506

Ferizal, A. A., Sobarnas, M. A., & Nursanto, D. (2021). Sistem Informasi Perpustakaan Berbasis Web di SMK Fatahillah Cileungsi. *INFOTECH : Jurnal Informatika & Teknologi*, *2*(2), 104–113. https://doi.org/10.37373/infotech.v2i2.178

Komarudin, U., Agustina, E. P., & Rolis, I. (2024). Institutional Repository Labschool Cibubur sebagai Implementasi Internet of Things (IoT) di Sekolah. *Jurnal Konatif: Jurnal Ilmiah Pendidikan*, *1*(2), 152–162. https://doi.org/10.62203/jkjip.v1i2.31

Onoyeyan, G. O., & Adesina, O. I. (2014). A literature review of the role of libraries in the provision of information towards the attainment of the United Nations Millennium Development Goals (MDGs) in Nigeria. *Library Philosophy and Practice*, *2014*(1).

Panigrahi, P. K., Sethy, S., & Dadhich, M. (2022). An Empirical Evaluation of Internet of Things (IoT) Implementations in the Libraries. *RESEARCH REVIEW International Journal of Multidisciplinary*, *7*(10), 116–124. https://doi.org/10.31305/rrijm.2022.v07.i10.014

Pramono, E., Andriyani, M., & Indra, J. (2020). Pengembangan Sistem Informasi Perpustakaan Dengan Internet Of Thing Menggunakan Perangkat Radio Frequency Identification Berbasis NodeMCU. *Techno Xplore*, *5*(2), 2.

Prasad, M. S., & Jahnavi, Y. (2019). *IoT Innovations in Libraries : Transforming Services and*

*Accessibility Department of Library Science , Government Degree College , Narsipatnam , Andhra Pradesh , India . * Corresponding Author : Y . Jahnavi. 10*(03), 1497–1503.

Pujar, S. M., & Satyanarayana, K. V. (2015). Internet of things and libraries. *Annals of Library and Information Studies*, *62*(3), 186–190.

Rahmani, M. (2022). Identifying and evaluating the challenges facing the management of digital libraries. *International Journal of Innovation Management and Organizational Behavior*, *2*(3), 1–11. https://doi.org/10.61838/kman.ijimob.2.3.1

Safdar, M., Rehman, S. U., Arif, M., & Ashiq, M. (2023). Research data services in libraries: a systematic literature review. *Information Discovery and Delivery*, *51*(2), 151–165. https://doi.org/10.1108/IDD-04-2021-0044

Saptari, J. (2023). Implementasi Perpustakaan Cerdas. *Media Informasi*, *32*(1), 38–48. https://doi.org/10.22146/mi.v32i1.6986

Shashidhara, K. L. (2023). *IoT and Its Application in Library: A Review of Emerging Trends IoT and Its Application in Library: A Review of Emerging Trends IoT and Its Application in Library: A Review of Emerging Trends*. *D*. https://digitalcommons.unl.edu/libphilprac

Simalango, H. M., & Naim Mursalim, K. M. (2019). Model Arsitektur Smart Library di Perguruan Tinggi Se-Kota Batam. *Journal of Applied Informatics and Computing*, *3*(2), 80–83. https://doi.org/10.30871/jaic.v3i2.1672

Sinha, P., & Brar, K. S. (2022). Application of Internet of Things (IoT) in Libraries. *Conference: International Conference on Knowledge Management in Higher Education Institutions (ICKHI 2022)*, *August*, 199–204. https://www.researchgate.net/publication/362544831_Application_of_Internet_of_Things_IoT_in_Libraries

Wardihani, E. D., Supriyo, B., & Sayekti, I. (2021). Penerapan Sistem Informasi dan Manajemen Perpustakaan Berbasis IoT di SDN Kramas, Tembalang, Kota Semarang. *Bhakti Persada*, *7*(1), 1–10. https://doi.org/10.31940/bp.v7i1.2160

Yeasmin, F. (2024). Systematic literature review on performance drivers of Ph.D. success: utilizing PRISMA, TCCM, and an 8-step approach. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2308438

Zareef, M., & Ahmad, P. (2021). The Impact of COVID-19 on University Library Services: A Systematic Literature Review. *Library Philosophy and Practice*, *2021*(July 2021), 1–13.