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Hybrid Library Models with AI-Driven-Embedding Electronic Resources into Conventional Library Services

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Abstract: **The proliferation of AI technologies is reshaping the traditional library's service, allowing libraries to utilize electronic resources, smart query, personalised recommendations, automated reference service, and virtual platforms. The purpose of this study is to investigate on hybrid librarianship models having embedded AI-based e-resources in traditional programmes of library services and how those library functions are perceived by user with particular focus on personalisation, user satisfaction, user engagement and perceived quality of service. This research is quantitative, descriptive and analytical and examines the experiences of users and library professionals associated with a hospital-based central library located in rural Uttar Pradesh, India. The research suggests the potential for accessibility, efficiency, resource discovery, and user-centred service delivery benefits using AI-powered services. It also considers issues such as technology infrastructure, implementation cost, privacy of data, algorithm bias, system integration and staff preparedness. The results suggest that AI-powered hybrid services have the potential to enhance personalization, satisfaction, engagement, and perceived value of the service. The study is a conclusion that the AI is not a replacement for the professional librarianship, but it can ease the work for them while providing accessible, efficient, and responsive library services.**

Keywords: **Artificial Intelligence, Hybrid Libraries, Electronic Resource, Conventional Library Services, Service Quality.**

1. INTRODUCTION

Libraries have been the backbone of knowledge sharing and serve as hubs for learning and enquiry. Libraries have been a reliable repository for human intellect and culture since times immemorial that have protected and passed on knowledge from generation to generation (Thaper, J. 2025). They provide access to resources and programs that support learning for people of every age, from early literacy to career growth. In many respects technology has made great progress and has revolutionized several fields such as libraries. The use of virtual assistants in modern-day libraries has revolutionized the way users communicate with library resources and have sought out information in recent years (ZHANG, L., et al., 2025).

The area of library uses extensively AI technology which revolutionizes the best service in information era time. Now the whole world of library technology is transformed in to revolution using AI. The library can be a part of this active information source for everyone by means of application of AI. AI can assist the library tremendously to automate the daily procedures and make service for the patron better and help in the organization and management of collections (Mitreva, E., et al., 2026). Library staff can spend more of their time assisting patron on in-depth research, on-going educational programs, or on personalized patron service. This allows the librarians to work more with patrons on more complex research, educational programming, and individualized patron interaction. The connection between AI and libraries is significant as artificial intelligence increasingly becomes part of library operations and services to facilitate job functions and improve

user experience and information handling. This connection is remagnifying the role of libraries as in today's digital era it has become a user-centred and dynamical information point (Khan, A. U., et al., 2026).

Central libraries, especially in a hospital, may have more than just the general provision of academic information, as the health care professionals, medical trainees and researchers and other authorized users will need to get access to reliable and specialized information in a timely manner. Combination of traditional collections and librarian-mediated services, and electronic medical literature, online databases, e-journals, e-books, digital repositories, AI-assisted information discovery, etc. is therefore possible in a hospital-based central library (Hashi, A. I., & Jama. 2025). Integration of these resources can assist in quicker literature search, evidence finding, reference service and individual access to relevant information. In rural health care environments, integration is especially applicable when users are more likely to rely upon information resources that are accessible electronically, as opposed to on-site, information collections and specialised information services (Hashi, Hussein., et al., 2026).

1.1 Integration of AI-Driven Electronic Resources in Hybrid Libraries

In this research, the term hybrid library model applies to a library service environment that combines traditional physical library services with the electronic information resources and AI-based digital technologies. In hospital-based central library, the hybrid model will integrate the physical library materials, reference materials, print journals, library circulation service, librarian-mediated reference service, electronic books (e-books), electronic journals (e-journals), subscribed bibliographic and full-text databases, institution/medical library repositories, online reference materials, digital library catalogue/OPAC, electronic document delivery service. This integration allows people to retrieve information from the library as well as the computer and/or from a mobile device. This hybrid model, then, does not imply a total transition from traditional to electronic library services but rather the simultaneous existence and integration of both types of library services.

AI has grown far beyond the simple clerical duties and now influences all aspects of a library's operations. In fact, much of the redefinition of the traditional library role includes the advancement of the use of AI-powered tools, especially “natural language processing (NLP)”, machine learning and data analysis. These technologies are vitally important for librarians in achieving various time-saving and mundane tasks in the library, including circulation and cataloguing. By automating routine tasks, librarians can “reclaim time and space for engaging library patrons and providing them with unique, specialized services that otherwise would be invested in manual tasks”(Ghosh, S., et al., 2024). In particular, AI recommendations are beneficial for personalisation because AI can examine patron behaviors, preferences and characteristics and use through analysis of data patterns, it can provide personalized recommendations. Thus, incorporating AI will optimize efficiency, can boost service, and can ultimately aid librarians in serving a wider clientele (Kumar, S., et al., 2026).

1.2 Integration of Electronic Resources and AI Technologies in Hospital-Based Central Library Services

Digital transformation does not mean replacing traditional library services, but rather the electronic resources and artificial intelligence technologies can complement the traditional services in a hospital-based central library. Conventional services like circulating, reference, bibliographic and/or full text research services, access to collections, and librarian-mediated information support can be combined with e-books, e-journals, electronic bibliographic and full-text databases, electronic archives and/or digital repositories, electronic catalogues and/or electronic document delivery (Mondal, D. 2025). With the help of AI-driven search and retrieval, relevant medical and scientific data can be identified, and recommendation systems can propose potentially relevant content according to the information needs of the users and their previous interactions. AI-based virtual reference can handle common reference questions, and AI-based classification and metadata can enhance resource retrieval. These technologies can be analyzed from the perspective of the user by perceived usefulness, ease of use, responsiveness, personalisation, reliability and accessibility, and based on these the satisfaction of the users with the hybrid library service environment can be examined from an empirical point of view (Demir, G. 2025).

1.3 AI-Enabled Technologies Considered in the Hospital-Based Central Library

AI enabled library technology in the present study is defined as the digital functionalities of the library that are being enhanced using some AI techniques to provide effective information discovery, retrieval, recommendation, reference and user support. The study explores five specific types of technology-enabled services: (i) AI-assisted information search and

retrieval, which enables natural-language or contextual search of electronic resources; (ii) AI-based recommendation systems, which suggest relevant books, journals, articles or other information resources based on users' search behaviour and information needs; (iii) AI-enabled virtual reference or chatbot services, which provide automatic answers to routine information and library-service queries; (iv) AI-assisted resource discovery and classification, which supports the generation, categorisation and better discovery of library resources; and (v) AI-supported personalised information services, which tailor information suggestions and digital library interactions according to users' preferences and usage patterns. The technologies are analyzed as part of the hybrid service environment of a library and their perceived usefulness, ease of use, responsiveness, personalisation and reliability are considered when evaluating users' satisfaction.

1.4 Challenges and Future Prospects of AI-Enabled Hybrid Library Models

➢ **Challenges:**

- **High implementations costs:** AI software, infrastructure of digital devices, etc. requires the expenditure and software, databases electronic for the library.
- **Technological Infrastructure**: A functioning internet access, cloud space, adequate hardware, technological support is necessities.
- **Data Privacy and Security:** There might be threats relating the issues of privacy, data privacy, user data security, user information breach in terms of misuse of AI for example it gathers user details to process (Bi, S., et al., 2022).
- **Difficulties of integration:** There may be problems in ensuring that artificial intelligence equipped digital resources are compatible with current library resources. The process of integrating AI into the current infrastructure may result technical difficulties.
- **Reliability and Bias:** AI does not always guarantee for the correctness for example search results may reflect some algorithm based on some biases.
- **Resistance to change:** Many may resist from applying these modern services or tools.

➢ **Future Prospects:**

- **Personalised Information Services:** AI can provide personalized recommendations and information services.
- **Improved Accessibility:** AI can assist in improving multilingual and/or voice and/or assistive access to electronic resources (Lalitha, B., et al., 2024).
- **Predictive Analytics:** Library is empowered for improving collection development services and planning using predictive Analytics.
- **Automated Library Services:** AI can help in reference services, cataloguing, circulation and other administrative duties in the library (Chhetri, P. 2023).

This study is designed to investigate the utilization of electronic resources integrated with AI-enabled library technologies in the traditional library services to create effective hybrid library models. It aims to explore how library users and staff members perceive the personalization, satisfaction, engagement, and quality of services by using the power of AI. In addition, the study seeks to identify the key technical, financial, privacy, infrastructure and organisational issues raised by the use of AI and to evaluate the potential for developed AI technologies to enhance attainable, effective and user-centred library services in the future.

2. REVIEW OF LITERATURE

Talasbek, A., et al., (2025)focused on the usage behavior of the e-books in academic settings and what academic staff expected an online platform to offer. The objectives were to evaluate e-book usage and to discuss some important features of digital libraries. This goal was to make known the choices of the users, and to assess the platforms they are using. The methodology used to conduct this survey, along with a comparative review of systems, namely “Perlego, QuizBot, Bookmate, Khan Academy and Scopus” was used. The results indicated significant needs for more informal sources, and more comprehensive collections, quiz generation, personalised recommendations, and tracking students' performance.

Shamsitdinova, M., et al., (2024)examined the role of Artificial Intelligence (AI) in improving information search and retrieval in digital libraries. In the context of problems that posed at the crossroads of ambiguous user queries, fuzzy, ambiguous and imprecise queries, the research has aimed to evaluate the process of improving effectiveness of query formulation and retrieval using the techniques of "Natural Language Processing (NLP) and Machine Learning (ML)" algorithms. It adopted the descriptive and analytical research methodology to analyse various search-based techniques using Artificial Intelligence (AI) such as automated, semi-automated, and manual. The results revealed that there was an improvement in contextual understanding, relevance and retrieval oriented to the user.

Huang, Y., et al., (2023)explored the emerging role of Artificial Intelligence (AI) in the Academic library in the evolving landscape of higher education. The goal was to understand the strategic responses of academic libraries to AI and make some comparisons between the developments in the UK and China. The goal was to hypothesize the applications of AI and the institutional priorities that were significant. Strategic documents from the top 25 QS-ranked universities in the United Kingdom and top 25 ranked universities in China respectively were analysed according to the methodology. The results revealed a limited focus on AI in UK approaches versus AI development in Chinese universities.

Subaveerapandiyan, A. (2023) examinedthe utilization of 'Artificial Intelligence (AI)' in libraries and the impact that this technology has on the functions of libraries was explored. The aim of this research is to provide the researchers with a detailed understanding of artificial intelligence in the library. The research approach entailed employing the Scopus database and pinpointing 66 pertinent publications concerning AI. After removing the duplicates and applying the filters, a thorough review was done of all 65 papers whose main findings and summary are outlined in this article. This data was a valuable resource for researchers studying AI's use in libraries.

Bi, S., et al., (2022) explored aspect of the "Artificial Intelligence (AI) and the Internet of Things (IoT)" as a key cause for the emergence of Smart libraries, with the backdrop of the pace of everybody becoming interconnected through smart devices and digital transformation. The main purpose of the study was to investigate the possible application of AI and IoT technologies in the library and to point the objectives of this study at the smart services, sustainability and security of libraries. Existing technological developments were taken up for analysing, using comprehensive review-based methodology. Results showed that these technologies were beneficial in improving service provision, operation sustainability and library security.

Omame, I. M., & Alex-Nmecha, J. C. (2020) examined that Artificial Intelligence (AI) had become a significant emerging technology in libraries which was changing traditional librarianship. This study was to analyse the current state of application of AI in Library operations and services and how it can improve service delivery to the library users. It aimed to evaluate the use of AI in systems like expert reference systems, robotic shelf-reading and virtual reality. The method used in the present study was descriptive method which used content analysis technique. The results showed better efficiency and service quality, suggesting that AI would enhance, not replace, the librarians' jobs.

2.1 Research Gap

The literature reviewed showed that past research concentrated on using AI, digital information retrieval systems, smart-library technologies and considering strategic use of AI in academic libraries. Yet few studies have focused specifically on how hybrid library models systematically combine AI-powered electronic resources with traditional libraries. Previous studies also lack the empirical understanding of the impact of such kinds of integration on service quality, usability and access, user engagement and operational efficiency. Additionally, there is a need to explore issues regarding infrastructure and security, staff preparedness, and integration with various systems. Thus, the present study fills the gap by exploring the integration of electronic resources integrated with AI-enabled library technologies into traditional library service and evaluating its future challenges and prospects.

3. RESEARCH OBJECTIVES

1. To investigate the effectiveness of AI-driven hybrid library services in improving personalization and user satisfaction.
2. To analyse the relationship between AI-enabled hybrid library services and user engagement and services quality.

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4. RESEARCH METHODOLOGY

A quantitative and descriptive and analytical research was designed and developed to understand the role of electronic resources and the role of AI-based technologies in utilizing traditional library services in the central library of a hospital in rural UP, India. The population studied were users from the central library of the hospital: medical/healthcare professionals, trainees/students, researchers, library users, and library professionals. It is a study of a mixed library service environment where traditional resources and services such as books, reference materials, print journals, circulation, and reference assistance by the librarian are supplemented with electronic resources and services, including e-books, e-journals, online bibliographic and full-text databases, digital repositories, electronic catalogues, and electronic document delivery services. The AI technologies that the study considers are AI-assisted information search and retrieval, AI-based resource recommendation, AI-enabled virtual reference/ chatbot services, AI-assisted resource discovery and classification, and personalised information-support functions. Primary data was collected from the respondents by using structured close ended questionnaire and secondary data was collected from the related scholarly literature to provide conceptual and contextual background of the study. AI-assisted search and retrieval, recommendation systems, virtual reference/chatbot support, AI-assisted resource discovery and personalised information services, were the four independent constructs that were AI-enabled hybrid library technology adoptions operationalized. The dependent constructs were user personalisation, user satisfaction, user engagement and perceived library service quality. Appropriate descriptive and inferential statistical methods were used to analyse data and examine the relationships between AI-enabled hybrid library technologies and the identified user outcomes.

5. RESULTS AND INTERPRETATION

In this section, the result of the data collected are briefly summarised and interpreted. To present and analyse the results in a systematic manner, the results are grouped on the basis of demographic characteristics, research objectives and hypotheses. Tables have been added to make the findings clear and then explanations were given to interpret the results. Such tables and their interpretations are stated with regards to research objectives as well as the formulated hypotheses.

Table 1: Results based on Demographic Profile

Sr. No.	Demographic Variables	Characteristics	N	%
1	Gender	Female	82	54.7%
		Male	68	45.3%
2	Age	18–25 years	32	21.3%
		26–35 years	38	25.3%
		36–45 years	34	22.7%
		46–55 years	27	18.0%
		Above 55 years	19	12.7%
3	Respondent Category	Library User/Student	68	45.3%
		Faculty/Research Scholar	47	31.3%
		Library Professional	35	23.3%
4	Educational Qualification	Undergraduate	30	20.0%
		Postgraduate	45	30.0%
		D.M./McH/Superspeciality Scholar	38	25.3%
		Professional/Other Higher Qualification	37	24.7%
5	Frequency of Library Use	Daily	42	28.0%
		2–3 times a week	39	26.0%
		Once a week	31	20.7%
		2–3 times a month	23	15.3%
		Rarely	15	10.0%

Table 1 presents the demographic characteristics of the 150 respondents. The gender distribution indicates that females made up of 54.7%, considering males to make up 45.3% of the respondents. In terms of age, the highest proportion belonged to the 26–35 years group (25.3%), followed by 36–45 years (22.7%), 18–25 years (21.3%), 46–55 years (18.0%), and those above 55 years (12.7%). As far as the category of respondents was concern, Library Users/Students, comprised of the largest group (45.3%) followed by the Faculty/Research Scholars (31.3%) and Library Professionals (23.3%). The educational qualification profile shows that the highest percentage (30.0%) consisted of those with postgraduate qualification while 25.3% had D.M./McH/Superspeciality Scholars, 24.7% had Professional/Other Higher Qualifications, and 20.0% were undergraduates. With regards to use of the library, the most frequent were users who used it on a daily basis (28.0%) followed closely by 2–3 times every week (26.0%) and once a week (20.7%), 2–3 times a month (15.3%) and hardly ever (10.0%). Overall, it suggests that the sample represented a range of professional, educational and library-use characteristics, providing varied perspectives on the use of conventional, electronic and AI-enabled library services within the hospital-based central library.

H1: AI-driven hybrid library services have a significant positive effect on personalization and user satisfaction among library users.

Table 2: Regression Table

Hypothesis	Regression Weights	Beta Coefficient	R^2	F	t-value	p-value	Hypothesis Result
H1	AI-driven Hybrid Library Services → Personalization and User Satisfaction	.514	.265	53.266	7.298	.000	Supported

Table 2 show the regression analysis results indicating that AI-driven Hybrid Library Services has significant positive effects on personalization and user satisfaction. The regression coefficient (β) of 0.514 represents a moderate positive correlation, suggesting that an increase in the personalization and satisfaction with library services, with the integration of artificial intelligence, leads to an increase in the AI tool's use in services. The regression coefficient (β) of 0.514 implies moderate positive correlation, indicating that the more the AI tool is adopted in library services, the higher the level of personalization and user satisfaction. The model had an R2 of 0.265, explaining 26.5% of the variance in personalization and user satisfaction. All the predictor variables are at 7.298 which is statistically significant, and the overall regression model is statistically significant at F = 53.266, p = .000. The p value is less than 0.05, which means that this null hypothesis is rejected, and the H1 hypothesis is accepted.

H2: There is a significant positive relationship between the adoption of AI-enabled hybrid library services and user engagement.

Table 3: Correlation Table

Hypothesis	Factor	Mean	SD	Pearson Correlation [r]	Sig. value	Hypothesis Result
H2	AI-Enabled Hybrid Library Services	27.4867	4.62851	.684	.000	Supported
	User Engagement	26.9133	4.81762			

According to Table 3 the correlation analysis reveals positively and significantly relationship between the retrieved factors and the outcome variables respectively. Moreover, there was a strong positive correlation between AI-Enabled Hybrid Library Services (r = 0.684, p = 0.000) and User Engagement, with a mean score of 27.4867 (SD = 4.62851) for AI-Enabled Hybrid Library Services and mean score of 26.9133 (SD = 4.81762) for User Engagement showing that the more effective and adopted the AI-Enabled Hybrid Library Services, the higher the users' engagement with the library. Information on the association between the two significance values are below 0.05, thus it is statistically proof of association.

6. DISCUSSION

An important development in library services today is indeed the shift towards hybrid library models, which merge the benefits of the physical library with electronic resources, digital systems and AI-driven technologies. AI can enhance resource finding, personalized suggestions, help Desk automation, Library metadata creation, and user support systems to increase the overall availability and effectiveness of library services (Asemi, Ko, & Nowkarizi, 2021). AI can help create an electronic environment that is more relevant to users' information needs and their information behaviors and still preserve the value of the professional guidance that is provided by a librarian (Cox, A, 2023). AI assisted chatbots, virtual reference library helpers etc. AI-assisted chatbots, virtual reference assistants, and other intelligent support tools can further assist users and reduce the routine tasks performed by library personnel (Okunlaya, R. O., et al., 2022). Although implementation of digital solutions necessitates the digital literacy, consideration about privacy, data protection and data handling, algorithmic bias, technological infrastructure and staff training (Chigwada, J. 2024). Therefore, the success of hybrid libraries that must make use of AI is not only dependent on the adoption of these technologies, but on the smart integration of electronic resources in the framework of traditional libraries and traditional services (Wheatley, A., & Hervieux, S. 2019).

Within a hospital-based central library, this integration is particularly relevant because users may require rapid discovery of specialised medical, scientific and professional information alongside access to conventional library collections. Electronic journals, e-books, bibliographic databases and digital repositories extend the information environment beyond the physical library, while AI-assisted search, recommendation and virtual reference functions can support users in locating relevant resources more efficiently. User satisfaction in this context therefore depends not only on the availability of electronic resources but also on the perceived usefulness, accessibility, responsiveness, reliability and personalisation of the AI-enabled services.

7. CONCLUSION

The study suggests that the hybrid library model that combines electronic resources and traditional library services can be implemented using AI technology to enhance the process of personalising services, user engagement, perceived service quality and satisfaction. AI-powered search, recommendation, virtual reference, and customised information solutions can support a more inclusive and responsive information environment in the context of a hospital-based central library in rural Uttar Pradesh, by leveraging the use of e-books, e-journals, online databases, digital repositories, and electronic catalogues. But it needs the right technological systems, knowledgeable librarians, and user digital literacy as well as data security protections and processes to ensure that information services provided by AI are reliable. The analysis of the findings should be based on the geographical and institutional setting of the chosen hospital based central library.

8. IMPLICATIONS, LIMITATIONS AND FUTURE RESEARCH DIRECTION

The study suggests that by combining e-resources with traditional library services, AI-powered hybrid library models can enhance personalisation, user engagement, service quality, and satisfaction. Libraries should, therefore, build appropriate infrastructure, train staff, build digital literacy, protect the privacy of users, and integrate the system well. The study, however, has been limited because of its quantitative approach and relatively small sample of 150 respondents and concentration of higher education institutes in Delhi NCR where the study is conducted, which might restrict the generalizability of the findings. Future studies should incorporate larger and geographically varied samples, comparative studies down the library type spectrum, and mixed methods to probe into the broader effects of AI, technological hurdles, experiences of users, and how AI is changing.

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