Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol

Tirtharaj Dasgupta[1], Madhumita Neogi[2] and Prof. Parthasarathi Mukhopadhyay[3]

Abstract: *This study aims to integrate Natural Language Processing (NLP) services within the DSpace-based repositories by using Model Context Protocol (MCP), a novel framework that promotes secured and seamless integration between LLM and external tools. This research study deployed Claude Sonnet as a front-end LLM and DSpace 9.1 as back-end digital repository software and connected them by using the MCP server to enable the natural language-based retrieval. This study highlights how MCP may allow context-aware NLP services to enhance metadata-driven retrieval and semantic search, as well as the multilingual information retrieval. It highlights the advantages of natural language-based retrieval and also identifies the limitations of this approach. This study reports developing a working prototype for natural language-based retrieval of DSpace and discusses the feasibility of this approach in real-world digital library settings, with a focus on large-scale national initiatives such as the National Digital Library of India (NDLI).*

Keywords: Natural Language Processing (NLP), Information Retrieval, Large Language Model (LLM), Model Context Protocol (MCP), DSpace, NDLI.

1. Introduction: Nowadays most of the modern libraries have developed multidimensional information management facilities for their users by which the libraries not only offer physical collections but also digital services, online repositories, and interactive information retrieval tools. In recent decades, the explosive expansion of digital information and the rising demand for quick access to resources have drastically changed the role of libraries. To organize, arrange, and find massive amounts of textual and multimedia data, effective computational approaches like Natural Language Processing (NLP) are critically important.

A subset of artificial intelligence (AI), natural language processing (NLP) focuses on how computers interact with human language to produce, decode, and evaluate written and spoken communication. Some examples of NLP techniques are named-entity recognition (NER), text summarization, sentiment analysis, machine translation, question answering, and parts of speech tagging. Nowadays NLP emerged as an essential approach in library and information science for improving metadata production, reinforcing information retrieval, dealing with digital preservation, and aiding semantic search.

By providing necessary amenities and streamlining text processing, NLP maximizes the accessibility, visibility, and user experience in a digital library system. Academic, research, and cultural organizations are widely used. DSpace is an open-source digital repository software that is developed by MIT libraries with the collaboration of HP Labs. DSpace is used to store, organize, and distribute digital content, including research papers, technical reports, multimedia files, and theses. Additionally, DSpace offers a unique metadata format based on standards like Dublin Core, which supports interoperability and long-term preservation and also makes it one of the most popular applications for managing institutional repositories. Its limited native capabilities for content analysis, semantic search, and automatic metadata production may make managing large and diverse digital collections challenging. Modern

[1] *Student, Department of Library and Information Science, University of Kalyani, tirtharajdasgupta963 @gmail. com*
[2] *Research Scholar, Department of Library and Information Science, University of Kalyani, madhumitalis25@ klyuniv.ac.in*
[3] *Professor, Department of Library and Information Science, University of Kalyani, psm@klyuniv.ac.in*

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

natural language processing (NLP) methods must be integrated with platforms such as DSpace in order to enhance metadata accuracy and information retrieval services as the amount of unstructured textual data in digital repositories grows. In India, a lot of academic and scientific institutions use DSpace to build digital libraries, archives, and institutional repositories. In fact, the backend of NDLI is based on DSpace.

The Model Context Protocol (MCP), which was introduced by Anthropic in November 2024, is an open-source framework that outlines how large language models (LLMs) interact securely and consistently with external tools, data sources, and workflows using JSON-RPC 2.0 messaging. It operates similarly to a "USB-C port for AI," facilitating smooth and interoperable tool invocation and metadata exchange between clients and servers (Anthropic, 2024). Prominent platforms such as OpenAI, DeepMind, Microsoft, Replit, Sourcegraph, and FuseBase have incorporated MCP, which has boosted the growth of its ecosystem. Developers gain advantages from decreased integration complexity, modular tool development, and compatibility across different platforms, while end-users benefit from scalable AI systems and improved workflows. Nevertheless, this rapid growth presents challenges; researchers have suggested frameworks like ScaleMCP and MCP-Zero to enhance tool selection dynamically and enable efficient lightweight invocation, targeting issues related to token overhead and scalability in multi-turn agent scenarios (Lumer et al., 2025).

Collectively, all of these developments make MCP a fundamental protocol in the era of agentic AI. NLP-enabled service integration has been made easier with Model Context Protocol (MCP), which also makes it relatively simple to improve digital library systems like DSpace. The new documents can be seamlessly analyzed by the MCP-compliant NLP server for the following tasks, like content summarization, subject classification, keyword extraction, and name-entity recognition in the digital repository system. Meanwhile, by offering access to NLP-based services for repository-specific metadata schema, vocabularies, or user queries, MCP facilitates semantically aware interaction, which improves the accuracy and relevance of the search result (Ethesham et al., 2025). The National Digital Library of India (NDLI) and other nationwide repositories greatly benefitted from these features because equal access to information depends on context-aware adaptation, multilingual semantic accuracy, and lastly, uniform metadata quality.

2. Relevant Literature: Large Language Models (LLMs) and external tools are able to communicate seamlessly because of the Model Context Protocol (MCP), which addresses issues with scalability, security, and dynamic tool integration. The architecture, applications, and drawbacks of MCP have been studied in a number of research papers. Numerous research studies have explored the potential benefits of artificial intelligence (AI) for improving library services, and research on its application in libraries remains ongoing. Nowadays the application of AI in library services is one of the most vital research topics.

Articles like Asemi et al. (2018) and Ali et al. (2020) explore how AI technologies are being implemented in Iranian and Pakistani libraries. Their studies reveal that the library professionals are fully aware of the latest advancements of AI, but they need proper training to implement those techniques of AI in their library to enhance the library services. These studies additionally emphasize the implementation of AI in the library operations and services. The efficiency of library services can be enhanced by the integration of machine learning (ML) techniques and explicit language, as reviewed by Panigrahi (2020) and Kumar et al. (2023). The above-mentioned articles have highlighted how sophisticated AI techniques help to improve information retrieval, cataloging, classification, indexing, and other library services. As stated by Kesuma et al. (2024) and Khan et al. (2024), artificial intelligence (AI) has the possibility to advance digital library services and promote sustainable ideas. In

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

addition to providing a fund for staff training, this research discovers the requirement of AI in libraries. Even though AI can enhance the library system, its implementation will need more research, financing, and learning. Application of NLP in library services is another most vital research topic. The use of NLP in digital library systems and its effects are explored by Mitra & Mukhopadhyay (2023) and Kesuma et al. (2024).

The mentioned studies demonstrate that NLP can reduce energy consumption and reliance on printed material while increasing the speed of the service and accuracy. It used a modular drag-and-drop interface to make the design and implementation of the NLP system much easier. Even non-technical users now may also access complicated NLP workflows because it supports integrating external services by using standardized API and Docker containers and its modeling of workflows as directed acyclic graphs. Model Context Protocol (MCP) has become popular because of the aim to improve the scalability, security, and interoperability of LLMs and their integration with other external tools. Detailed evaluations of MCP were given by Ray (2025) and Singh et al. (2025) that discussed the architecture, security features, and applications of MCP in various domains.

According to Patil & Lokhande (2025), MCP is important for supporting context-aware communication, boosting decision-making, and increasing system responsiveness. On the other hand, the drawbacks of direct MCP connection have been discussed by Ahmadi et al. (2025). In this study they also introduced MCP Bridge, which is a lightweight, LLM-agnostic RESTful proxy for MCP servers that provides additional safety controls. Neogi et al. (2025) developed an experimental information retrieval system by integrating VuFind with Claude Desktop through MCP as middleware. This system significantly improves search accuracy and the user experience. Liu and Du (2025) proposed an MCP-based Internet of Expert framework, in which they discussed the ability of LLM (in a wireless manner) and the awareness of reasoning capabilities. Patil (2025) emphasizes in his discussion how MCP has the potential to redefine data communication and system interoperability. This study also focused on the evolution, characteristics, and architecture of MCP and how it differs from other protocols like TCP/IP, MQTT, and REST APIs.

This study shows the effectiveness of MCP in IoT integration. Hou et al. (2025) examine the workflow and the security and privacy threats of MCP in different stages. On the other hand, Hasan et al. (2025) and Radosevich and Halloran (2025) point out different weaknesses and security-related concepts related to MCP and also mention that vulnerability detection methods are required. Radosevich & Halloran (2025) also developed a tool, named 'MCPSafetyScanner,' to evaluate the security of MCP servers. Jing et al. (2025) have suggested a unique framework called Model Contextual Integrity Protocol (MCIP). This framework enhanced the safety performance of LLMs.

3. Objectives of the study: In this study we used Model Context Protocol (MCP) as a middleware to examine the possibility of incorporating a Natural Language Processing (NLP) user interface that utilizes large language models (LLMs) into DSpace software. Creating a creative, context-aware retrieval system that improves user experience in a digital library system is the goal. The following are the main goals of this study:

3.1 Development of Prototypes: Designing and implementing a prototype based on natural language processing (NLP) that analyzes Model Context Protocol (MCP) with the goal of smoothly integrating DSpace with Claude desktop and facilitating NLP-based interaction with the material from digital repositories.

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

3.2 Enhancement Assessment: To assess the potential of Claude desktop as an NLP tool to enhance DSpace's content discovery services, with an emphasis on user query interpretation and search accuracy.

3.3 System Evaluation: To comprehensively assess the prototype's reliability and practical viability while identifying implementation challenges and system limitations and providing recommendations for broader AI integration strategies in digital library infrastructures.

Through the achievement of these objectives, this study seeks to demonstrate the transformative potential of incorporating AI-driven services into large-scale digital libraries. By utilizing standardized interoperability protocols such as MCP, the research aims to establish a framework for enhancing digital repository functionality (here DSpace version 9.1) while maintaining system compatibility and scalability.

4. Methodology: This discussion in this section presents a four-layer methodology, outlined across four sections:

4.1 Overview of the methodology: Natural language retrieval has been tested on a digital library built on DSpace 9.1. It uses Claude Desktop as a front-end to receive user queries. Claude Sonnet is used as an LLM that analyzes the user query, and utilizes the MCP server built for retrieval from the DSpace back-end using its API endpoint. Figure 1 demonstrates the overview of the methodology.

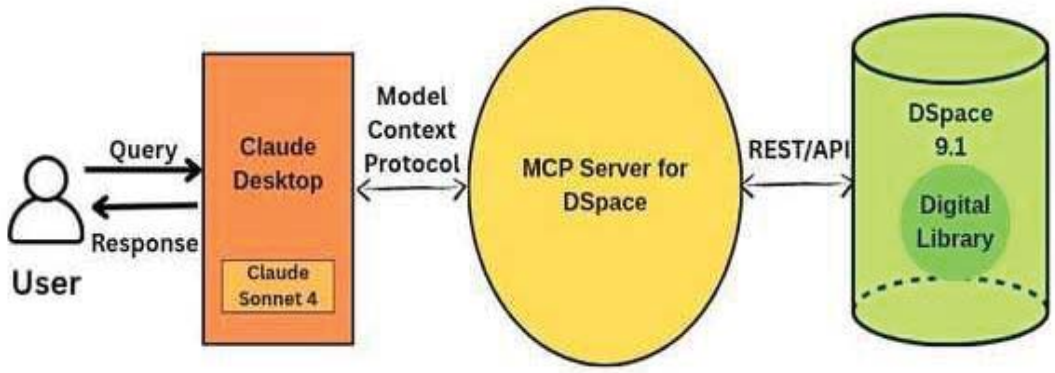

Figure 1: MCP framework

4.2 Creating a digital library back-end using DSpace 9.1: DSpace is an open-source software used for building digital libraries and repositories. It has been widely used for building multiple digital libraries, especially in India like the National Digital Library of India (NDLI), Sodhganga, E-gyankosh, multiple institutional repositories, etc. For the purpose of this research, DSpace 9.1 has been used (the latest stable release as on 31st August, 2025), because of the features it provides, its stability, and the well documented official support. It is built on an Angular JS-based front-end and a REST/API back-end. There are many REST/API endpoints which allow various functionalities. A collection of around 1000 open access journal articles, obtained from Semantic Scholar was created in DSpace. Metadata elements (Dublin Core) were filled for each document, along with the file of the item and the associated licenses were agreed to. This has been created under a structured hierarchy of community and sub-community.

4.3 Testing the REST/API endpoints for retrieval from the digital library: The REST/API back-end can be accessed using the URL http://localhost:8080/server, which lists and allows testing and usage of the available API endpoints. The API service allows various users to avail to the features from different places. The REST/API provided by DSpace 9.1 serves as the basis of the implementation of the MCP server that would be implemented and used for

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

natural language retrieval of information from the digital library. The common part of the REST/API URL, used to search for information about the items in the digital library is http://localhost:8080/server/api/discover/search/objects, where we can append various metadata elements. For the case of this research, a more generic term query has been used to search into the digital library based on the query passed by the user. Figure 2 demonstrates the results upon a search using the query "Model Context Protocol" at the DSpace 9.1 back-end using API.

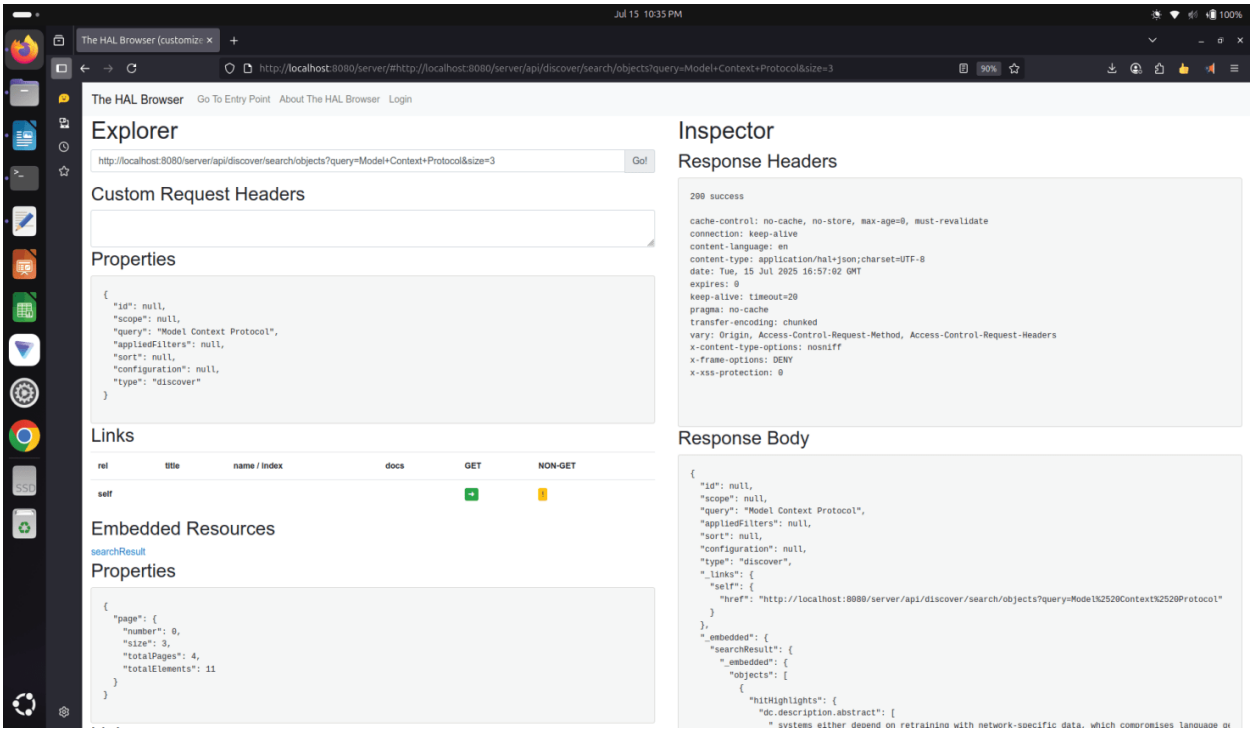

Figure 2: Usage of the API endpoint for searching the DSpace collection

4.4 Implementing an MCP Server for Dspace: A Python-based MCP server has been implemented using the capability of making API calls. It has been based on the MCP Server for Vufind, available at https://github.com/jaohbib/MCP-for-VuFind. It has been written in Python programming language. The following schematic steps have been taken to implement it for DSpace.

4.4.1 Modifications specific to DSpace 9: Using the MCP server for VuFind as a base (Neogi et. al, 2025), specific modifications have been made to use the DSpace 9 REST API endpoint. A tool has been designed that uses DSpace REST API endpoint to search the collection in the digital library. It provides an additional capability to the LLM to work as an agent in doing external tasks. The LLM gets the capability of searching the digital library after analysis of the natural language query. The server has been saved as server.py.

4.4.2 Preparation of a configuration file: The customized MCP server has been put in a designated directory alongside a config.ini file. The configuration file contains the base URL for running DSpace server under port 8080 of server, designated as localhost. A proper connection has been established between the configuration file and the server, for its proper execution.

4.5 Configuring front-end to enhance functionalities of Claude Sonnet: Claude Desktop, built by Anthropic, has been used as the front-end, because it provides an in-built capability to integrate MCP servers. A Windows 11 system has been used to work with Claude Desktop,

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

because of the availability of an official package for the operating system, provided by Anthropic, which Debian-based systems lack. It hosts the MCP client for the purpose. Claude Desktop's configuration file can be modified to include the path to, and the command to run the MCP server, in order for it to act as a MCP client. Claude Desktop provides a set of LLMs to be used, among which Claude Sonnet 4 has been used because it is good as a smart and efficient model, and is free to use, although it provides a limit on the number of tokens it can process during a time period. At the user interface of the AI assistant, queries can be asked, which is analyzed by the LLM and the information is retrieved using the MCP server.

5. Results: Natural language queries were given to the MCP framework, and the LLM (here Claude Sonnet model) analyzed the query and generated answers based on the bibliographic data available from DSpace.

5.1 Subject searching: When the LLM was asked if any works were available on the subject "AI Security", it generated an answer listing the resources mentioning the title, the authors, the DOI, and the focus of the resource, that has been generated by the LLM based on the available bibliographic data obtained on-the-fly through REST/API query from DSpace. According to Figure 3, four results were obtained. However, when retrieving items from the DSpace collection, only two documents were found with the subject metadata element value "AI Security." The additional two results were included because the MCP framework was able to extend the search semantically, retrieving related papers even without the target keyword. The resources available in DSpace are shown in Figure 4.

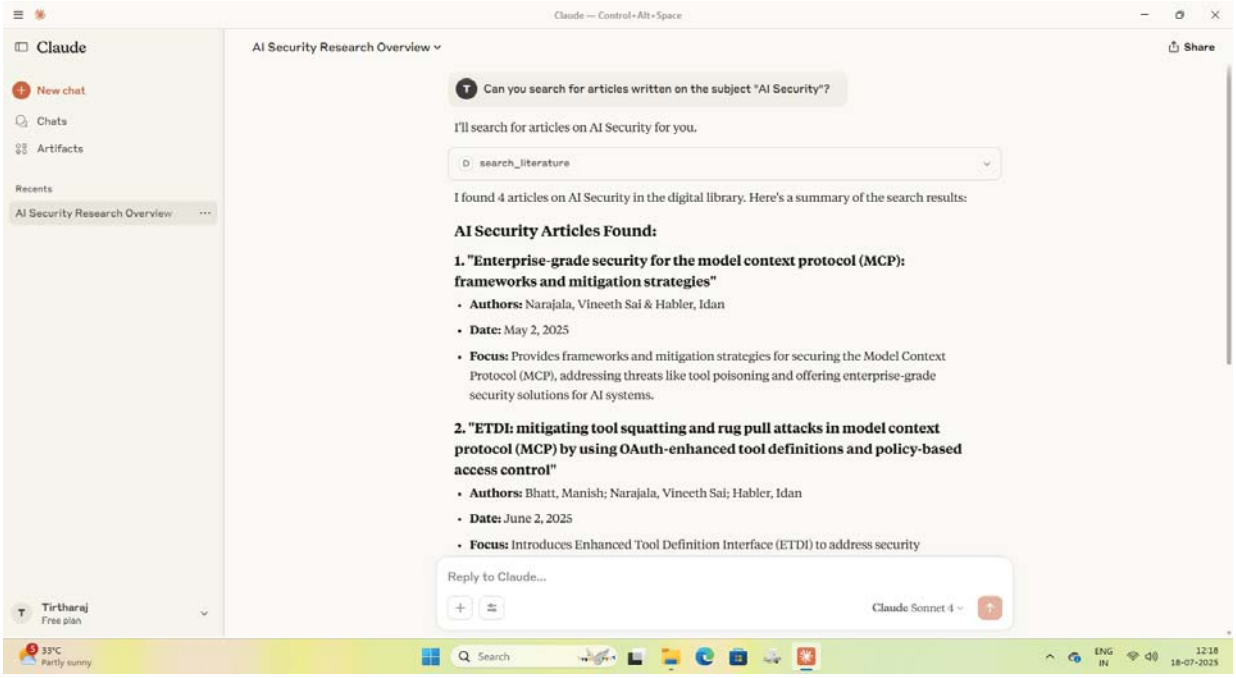

Figure 3: Natural language retrieval of resources on the subject "AI Security" using LLM

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

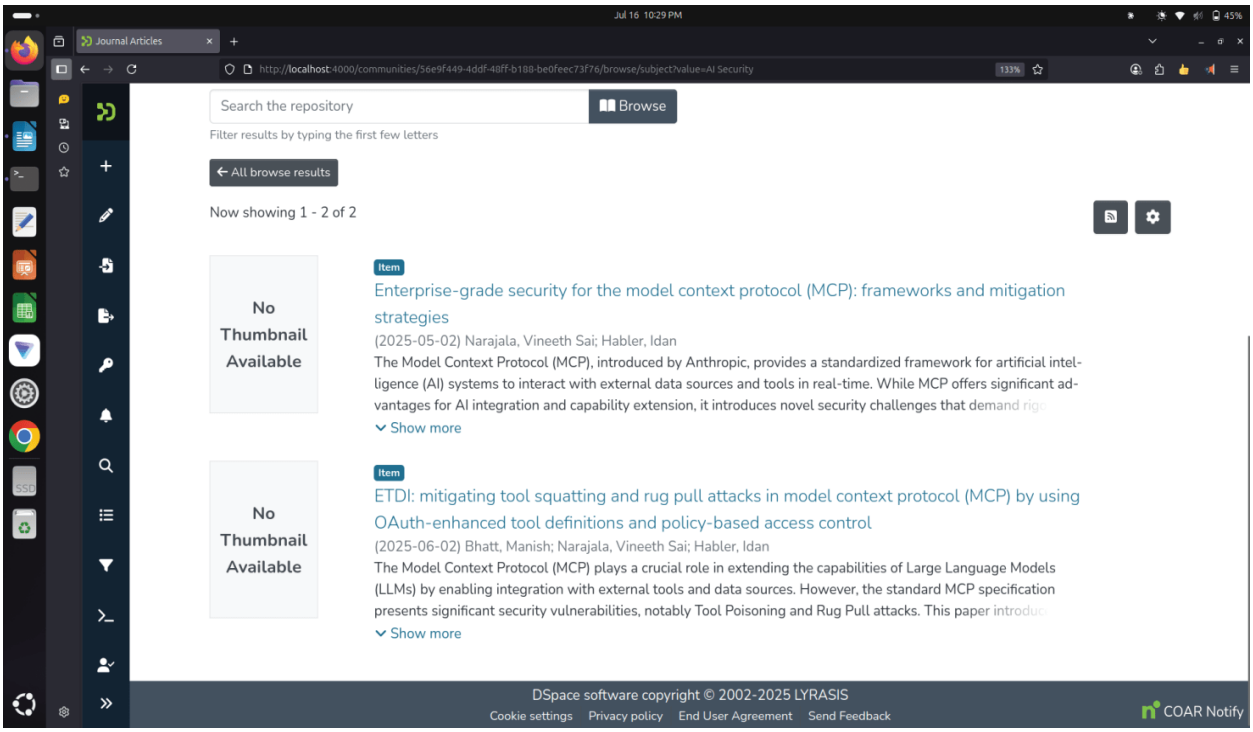

Figure 4: Resources in DSpace Collection on the subject "AI Security"

5.2 Author searching: When the LLM was asked to search for documents written by Naveen Krishnan, it was successfully able to retrieve the only resource written by the mentioned author, and it was same as retrieved from DSpace. Along with this, as it was mentioned in the query to provide the abstract in a tabular format, it was able to generate a table containing abstract and other information in the table as well as following section. Figure 5 shows the results of LLM search, and Figure 6 shows the appropriate resources in DSpace.

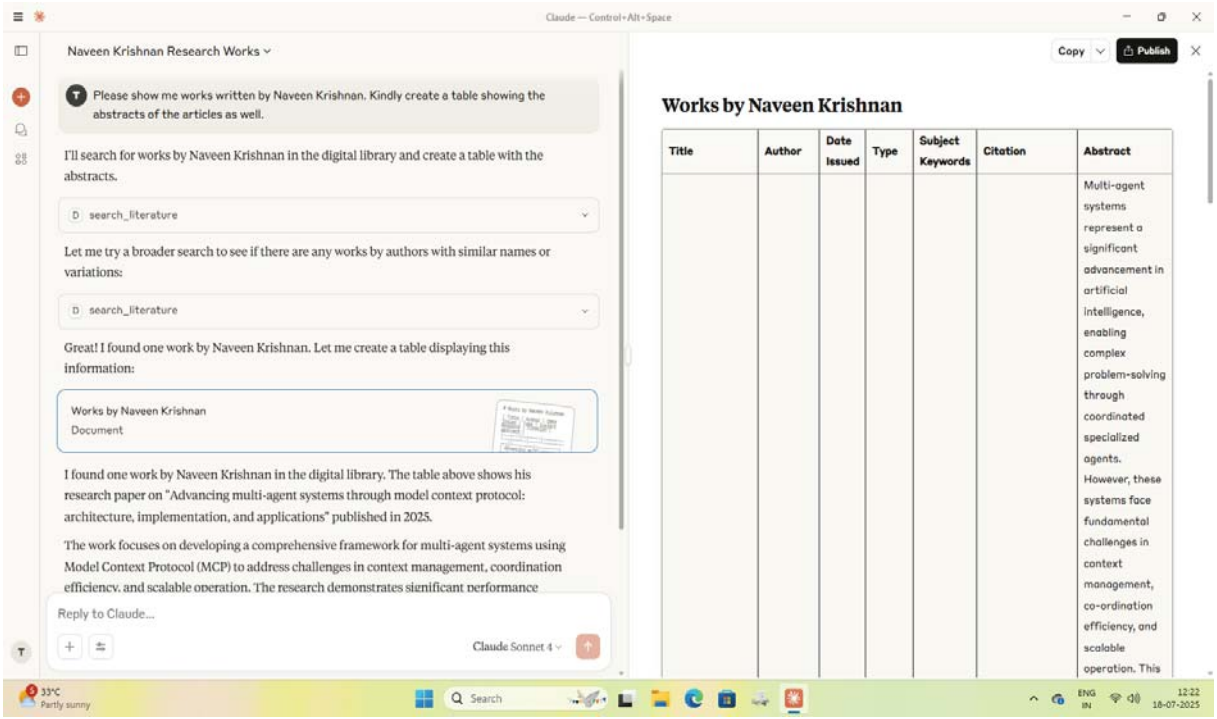

Figure 5: Retrieval of documents by a given author along with the abstract from MCP interface

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

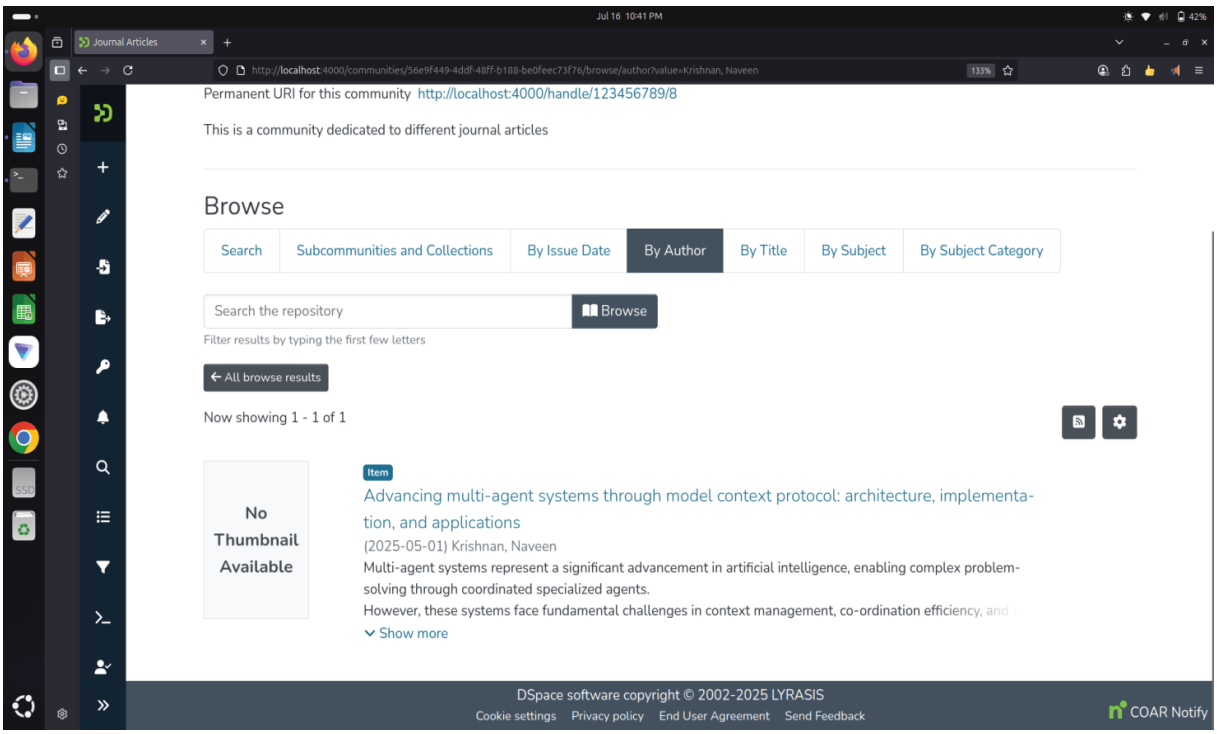

Figure 6: Resources in DSpace Collection written by a given author

According to Figure 5, it is evident that proper prompting of LLM to perform the task of providing the abstract resulted in better retrieval. In this case, the results provided by the LLM as well as DSpace were the same.

5.3 Date-wise sorting: When the LLM was asked to list all the results and sort them by date, it wasn't able to perform the task, and showed that the collection had 0 articles. This has been shown in Figure 7. But when the LLM was asked for a particular author and the results were asked to be sorted chronologically, it successfully did such, as shown in Figure 8.

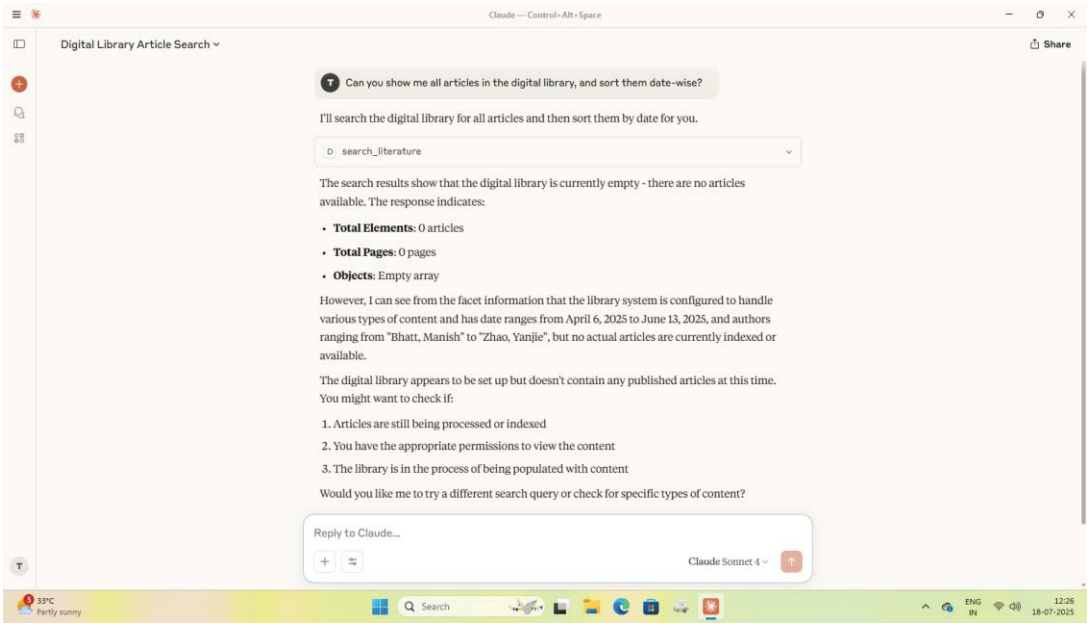

Figure 7: Failure of LLM in listing all the resources and sorting them by date

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

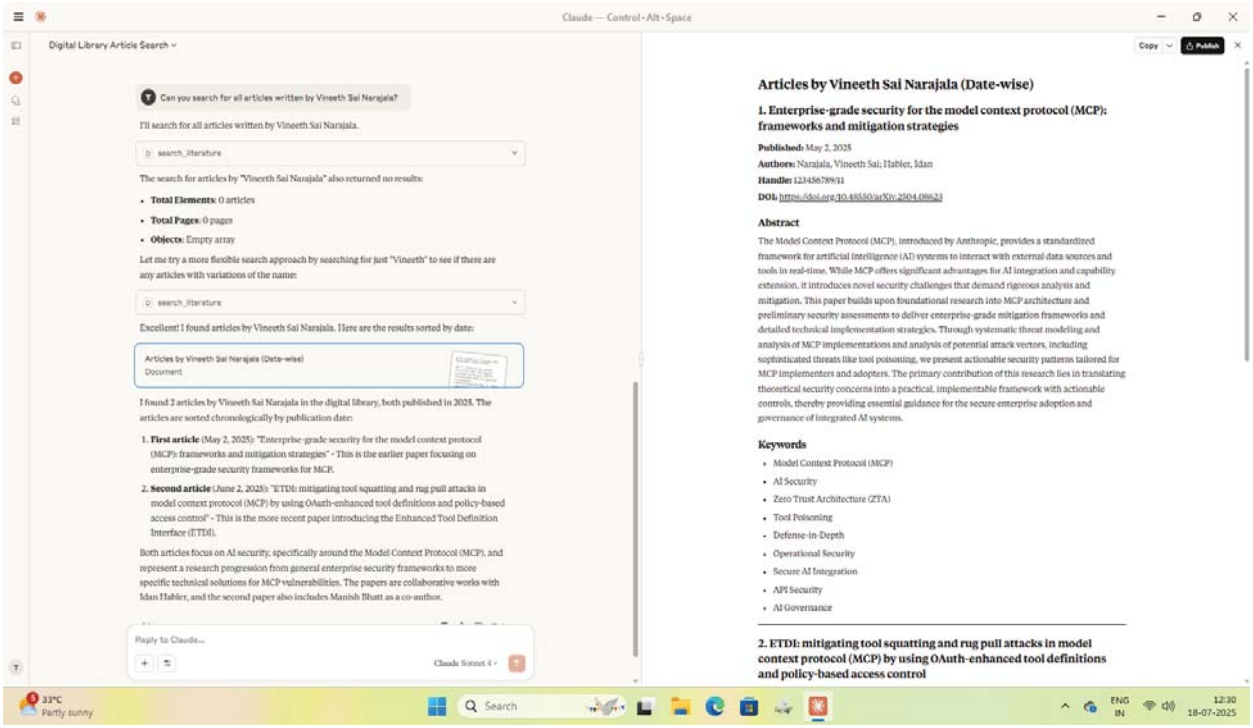

Figure 8: Sorting of all results of an author search by LLM

6. Conclusion: Over the years, libraries have continuously improved retrieval capabilities by adopting emerging technologies. Initially, OPACs added the advantages of back-end RDBMS and text retrieval engines such as Zebra, Lucene, Solr, and Elasticsearch to enhance search efficiency. In the era of Google, libraries explored web-scale discovery systems using platforms like VuFind, EDS, Primo Central, and others, enabling users to search across vast collections in a single interface. Now, with the advent of LLMs such as GPT-5, Gemini, Claude, and similar models, the time has come to embrace natural language-based retrieval that can understand and respond in natural language, bridging the gap between user intent and bibliographic data.

Large Language Models have the potential of revolutionizing the system of information retrieval. The power of generation in natural language coupled with the capability of retrieval may do wonders. Although Retrieval Augmented Generation (RAG) is able to work with a set of document vectors and retrieve results by checking similarity with the query vector, it is unable to perform retrieval from an already designed digital library. The current research aims to solve the problem with the power of LLMs and MCP server. This study lacks the demonstration of the usage of various open source LLMs (that is LLMs other that Claude Sonnet model) and check how they retrieve bibliographic information from digital libraries using the MCP server and generate answers. For this, a further research path is open for creating an AI agent or a chatbot that can include an MCP client. It shall be able to integrate various LLMs like DeepSeek, Mistral, Llama, etc. and test how they retrieve information from the digital library. Alongside this, if the digital libraries provide an in-built interface that would use the power of LLMs and MCP server to allow natural language retrieval, it would work as well. The later would ensure more trust and data privacy. A proposal is put to all digital libraries that have been built using DSpace, to make full use of their REST/API endpoint. This would allow LLMs to use the bibliographic data, and generate responses upon a user query. They may integrate an in-built natural language search interface, as well as provide their API endpoints available to an external software, that would include an MCP

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

server. Natural language-based retrieval has the potential of revolutionizing the whole scenario of information retrieval, be it plain library catalogue searching or searching a digital library. This would allow users retrieve their required information better and in a more lucid way.

References

1. Ahmadi, A., Sharif, S. S., & Banad, Y. (2025, April). MCP bridge: A lightweight, LLM-agnostic RESTful proxy for model context protocol servers. https://arxiv.org/abs/2504.08999
2. Ali, M. Y., Naeem, S. B., & Bhatti, R. (2020). Artificial intelligence tools and perspectives of university librarians: An overview. *Business Information Review*, *37*(3), 116–124. https://doi.org/10.1177/0266382120952016
3. Asemi, A., & Asemi, A. (2018). Artificial intelligence (AI) application in library systems in Iran: A taxonomy study. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/1840/
4. Ehtesham, A., Singh, A., Gupta, G. K., & Kumar, S. (2025, May). A survey of agent interoperability protocols: Model context protocol (MCP), agent communication protocol (ACP), agent-to-agent protocol (A2A), and agent network protocol (ANP*)*. arXiv. https://doi.org/10.48550/arXiv.2505.02279
5. Hasan, M. M., Li, H., Fallahzadeh, E., Rajbahadur, G. K., Adams, B., & Hassan, A. E. (2025, June 16). Model context protocol (MCP) at first glance: Studying the security and maintainability of MCP servers. https://doi.org/10.48550/arXiv.2506.13538
6. Hou, X., Zhao, Y., Wang, S., & Wang, H. (2025). Model context protocol (MCP): Landscape, security threats, and future research directions. arXiv. https://doi.org/10.48550/ARXIV.2503.23278
7. Jing, H., Li, H., Hu, W., Hu, Q., Xu, H., Chu, T., Hu, P., & Song, Y. (2025). MCIP: Protecting MCP safety via model contextual integrity protocol (Version 4). arXiv. https://doi.org/10.48550/ARXIV.2505.14590
8. Kesuma, A. R., Saputra, J. H., Amaliah, E., & Iqbal, R. (2024). Optimization of digital library services using artificial intelligence (AI): Approach to green library. *Tik Ilmeu : Jurnal Ilmu Perpustakaan Dan Informasi*, *8*(2), 183–194. https://doi.org/10.29240/tik.v8i2.11421
9. Khan, R., Gupta, N., Sinhababu, A., & Chakravarty, R. (2024). Impact of conversational and generative AI systems on libraries: A use case large language model (LLM). *Science & Technology Libraries*, *43*(4), 319–333. https://doi.org/10.1080/0194262X.2023.2254814
10. Kumar, A., Yadav, N., & Student, M. (2023). *Empowering library system with AI: A roadmap of AI in Indian academic libraries system*. https://ijrti.org/papers/IJRTI2310093.pdf
11. Liu, Z., & Du, H. (2025). *Model context protocol-based Internet of experts for wireless environment-aware LLM agents* (version 1). arXiv. https://doi.org/10.48550/ARXIV.2505.01834
12. Lumer, E., Gulati, A., Subbiah, V. K., Basavaraju, P. H., & Burke, J. A. (2025). *ScaleMCP: Dynamic and auto-synchronizing model context protocol tools for LLM agents* (Version 1). arXiv. https://doi.org/10.48550/ARXIV.2505.06416

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.

13. Mitra, R., & Mukhopadhyay, P. (2023). Machine learning applications in digital humanities: Designing a semi-automated subject indexing system for a low-resource domain. *DESIDOC Journal of Library & Information Technology*, *43*(04), 219–225. https://doi.org/10.14429/djlit.43.04.19227

14. Mohanty, S. P., Wani, N. J., Srivastava, M., & Sharma, D. M. (2016). Kathaa: a visual programming framework for NLP applications. *Proceedings of the 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Demonstrations*, 92–96. https://doi.org/10.18653/v1/N16-3019

15. Neogi, M., Dasgupta, T., & Mukhopadhyay, P. (2025). NLP-based library retrieval: Integrating VuFind with LLM through MCP middleware. *Indian Journal of Information Library & Society*, *38*(1–2), 1–19. https://doi.org/10.5281/ZENODO.16084058

16. Panigrahi, D. P. (2020). *Developing intelligent systems for library works and services using declarative language: A case study of library classification*. https://www.caluniv.ac.in/academic/LibSc/Study/Developing-Intelligent.pdf

17. Patil, M., & Lokhande, V. (2025). Model context protocol (MCP): Enabling scalable AI data integration. *IJFMR*, *7*(2), 43583. https://doi.org/10.36948/ijfmr.2025.v07i02.43583

18. Patil, P. (2025). Inside the MCP protocol: Revolutionizing data communication and system interoperability. *World Journal of Advanced Research and Reviews*, *26*(1), 3055–3071. https://doi.org/10.30574/wjarr.2025.26.1.1401

19. Radosevich, B., & Halloran, J. (2025, April). *MCP safety audit: LLMs with the model context protocol allow major security exploits*. ArXiv. https://doi.org/10.48550/arXiv.2504.03767

20. Ray, P. P. (2025, April). *A survey on model context protocol: Architecture, state-of-the-art, challenges and future directions*. https://doi.org/10.36227/techrxiv.174495492.22752319/v1

21. Singh, A., Ehtesham, A., & Kumar, S. (2025, April). *A survey of the model context protocol (MCP): Standardizing context to enhance Large Language Models (LLMs)*. https://doi.org/10.20944/preprints202504.0245.v1

22. Wikipedia contributors. (2025, May 22). Model context protocol. In Wikipedia, The Free Encyclopedia. https://en.wikipedia.org/wiki/Model_Context_Protocol

Postprint
Dasgupta, T., Neogi, M. & Mukhopadhyay, P. (2025). Enhancing Dspace with Large Language Models: Designing an Integration Framework Using the Model Context Protocol. Proceedings of the 4th International Symposium on Knowledge Engineering in Digital Library Design (KEDLD-2025), 235-245.