

## A Campus-Wide AI - Driven Information Retrieval & Support System

<sup>1</sup>Omorogiuwa O. & <sup>2</sup>Adekoya S. A.

\*<sup>1,2</sup> Department of Computer Science & Information Technology  
Igbinedion University, Okada, Edo State, Nigeria

\*Corresponding Author Email: [ask4osas@iuokada.edu.ng](mailto:ask4osas@iuokada.edu.ng)

\*ORCID ID: 0000-0003-2105-8220

### ABSTRACT

The rapid advancement of Artificial Intelligence (AI) has significantly transformed most information retrieval processes in organizations making it more efficient, interactive and context-aware. This paper addressed the limitations of the existing information retrieval system in the university, which did not keep pace with the capabilities offered by modern AI technologies. To overcome these shortcomings, a campus-wide AI-Driven Information Retrieval and Support System was developed. This solution leverages Retrieval-Augmented Generation (RAG) and AI-powered Natural Language Processing (NLP) to provide accurate, context-sensitive responses to queries. The system integrates a vector database and an intuitive web interface using JavaScript, to process and retrieve data efficiently from diverse university sources. The AI-driven solution was designed to enhance access to university resources and provides a scalable foundation for future features, ultimately bridging the gap between users and institutional information.

**Keywords:** Artificial Intelligence, Information Retrieval (IR), Natural Language Processing, (NLP), RAG Chabot, Large Language Models (LLM), Retrieval-Augmented Generation

---

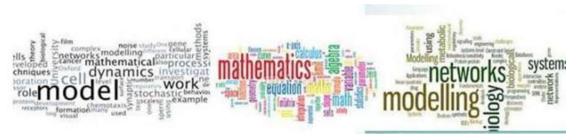
Omorogiuwa O. & Adekoya S. A. (2022): A Campus-Wide AI - Driven Information Retrieval & Support System. *Journal of Advances in Mathematical & Computational Science*. Vol. 13, No. 3. Pp 79-87. Available online at [www.isteam.net/mathematics-computationaljournal](http://www.isteam.net/mathematics-computationaljournal). [dx.doi.org/10.22624/AIMS/MATHS/V10N4P4](https://doi.org/10.22624/AIMS/MATHS/V10N4P4)

---

### 1. INTRODUCTION

Information Retrieval (IR) is a branch of Computer Science focused on locating relevant information within large datasets based on user queries. The primary objective of IR is to identify, rank and present documents or data that best match the user's intent. This process involves several stages, including query processing, document organization and the application of algorithms to score and rank results by relevance (Smith & Chen, 2023). Academic IR emphasizes precision, relevance and the academic validity of retrieved information.





In contrast, RAG employs dense retrieval techniques that capture semantic similarities in embedding space, enabling it to retrieve more contextually appropriate content even if the exact terms are not used (Karpukhin et al., 2020). A fundamental limitation of these traditional models is their inability to interpret the semantic context of queries. They treat queries as mere collections of keywords without understanding the user's intent or the underlying meaning of terms. This absence of contextual and semantic processing significantly reduces precision, especially in specialized domains where accuracy and nuanced understanding are crucial (Patel et al., 2025). Consequently, there is an increasing need to adopt advanced IR techniques that integrate natural language understanding and semantic search to enhance retrieval performance and user satisfaction. Natural Language Processing (NLP) is a core technology that allows machines to process and understand human language. In an academic context, NLP enables a system to go beyond basic matching and use techniques like semantic analysis to interpret the meaning and intent behind a user's query. Large Language Models (LLMs) often based on the Transformer architecture, have further enhanced the capabilities of NLP.

Models like BERT (Bidirectional Encoder Representations from Transformers) are pre-trained on massive text corpora, giving them a broad knowledge base and advanced skills in understanding and generating language. Retrieval-Augmented Generation (RAG) is a sophisticated architecture that combines the strengths of information retrieval and generative models like LLMs. First proposed by Lewis et al. in 2020, RAG is a two-stage process that leverages an external knowledge source to ground its generated responses. The mechanism of RAG involves a dense retriever and a sequence-to-sequence generator. In the first stage, a retriever system uses dense vector representations of a query to find the most relevant documents or passages from a knowledge base. The second stage then feeds these retrieved documents into a generative model, which uses this external context to craft a coherent, factually accurate and contextually grounded response. AI systems, however, continuously learn and adapt, refining their models as they gather more data, which helps keep results relevant and useful over time (Xie et al., 2020).

These systems also handle new information better, often requiring less manual updating than older systems that need to be re-indexed periodically. The trend of integrating technology into the academic information retrieval system is growing worldwide. Leading universities are applying innovative solutions to improve the effectiveness and efficiency of academic information retrieval and management, (Hien & Khiet, 2025). The successful implementation of AI-driven support systems in other universities e.g. Georgia State University developed an Artificial Intelligence system called "Pounce" Chatbot, Deakin University's developed "Genie Digital Assistant" and University of Murcia in Spain introduced AI-powered Chabot to assist students with academic advising and course selection (Fernández et al., 2021). These implementations demonstrate that the most effective AI systems are not merely static repositories of information. Instead, they are deeply integrated into the institutional ecosystem, providing personalized, proactive support that improves both efficiency and student satisfaction. The documented challenges of systems operating in "silos" and their limited adaptability highlight the need for a unified, campus-wide approach.









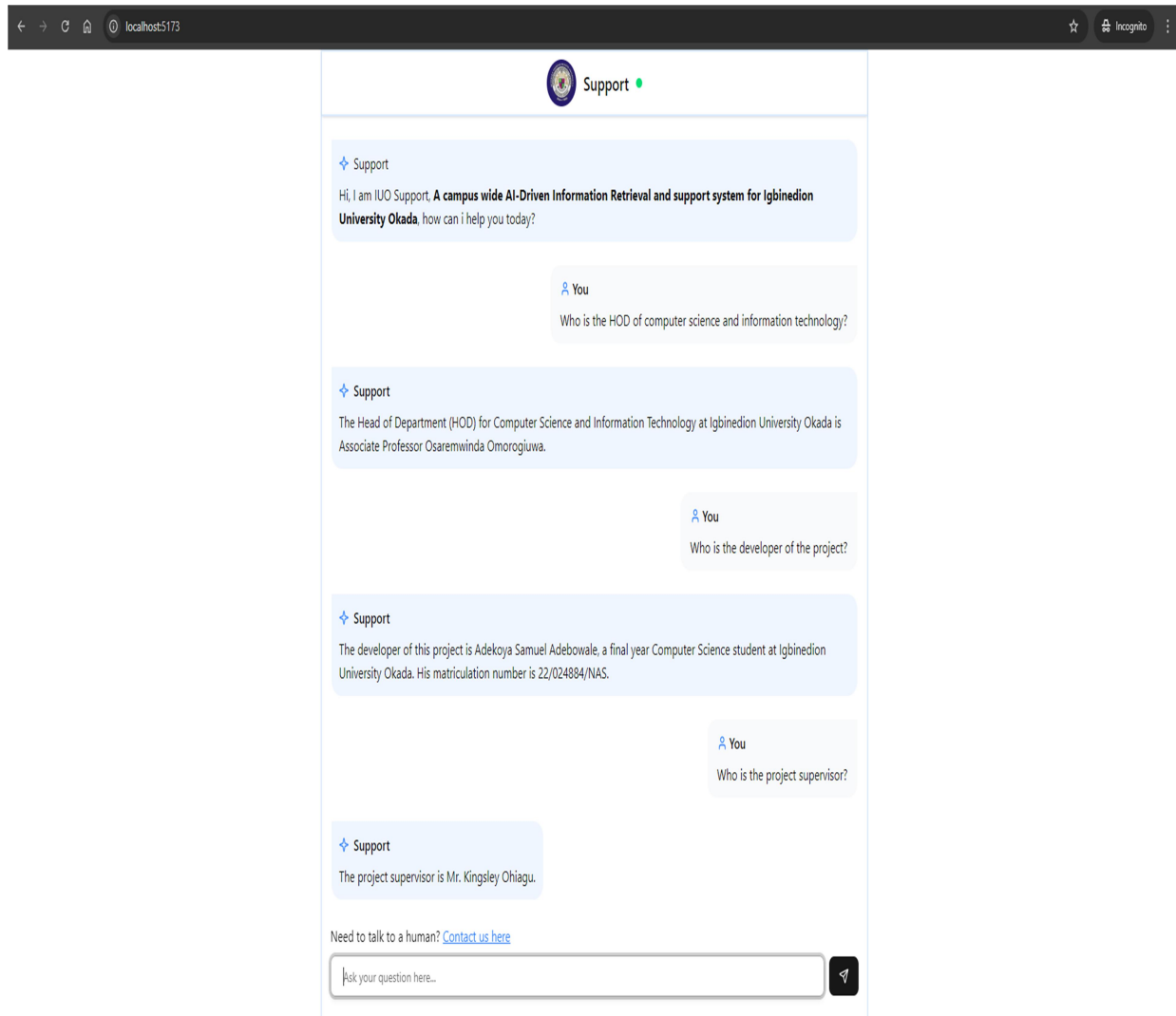
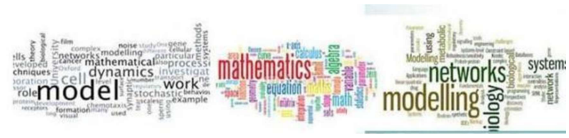


Figure 4 Chat Page

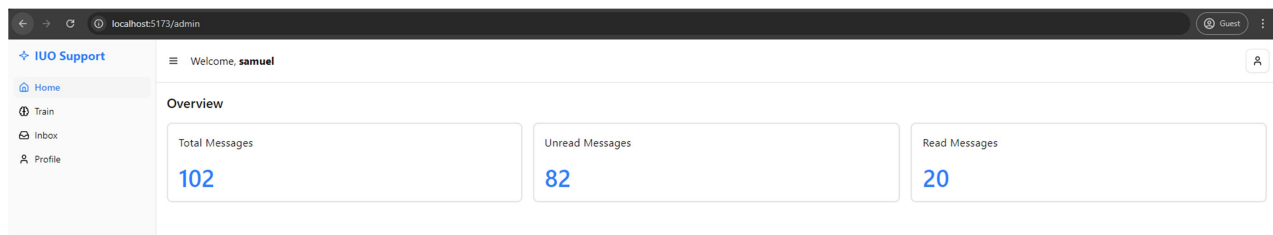
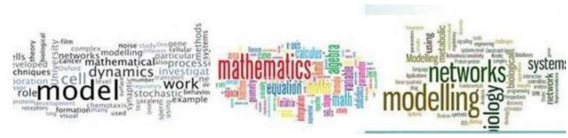


Figure 5 Admin – Dashboard Page



The key outcomes of the project include a reduction in the time spent searching for information and a more efficient administrative support process, thereby enhancing the overall user experience and fostering a more productive academic environment at Igbinedion University. By automating responses to repetitive inquiries, the system also reduced the administrative workload, allowing staff to focus on more critical tasks.

## 6. CONCLUSION

The development of the AI-driven Information Retrieval and Support System represents a significant modernization of information management at Igbinedion University. By adopting a structured methodology and leveraging advanced AI technologies, the research output has successfully addressed the core problem of inefficient information access. The system provides a smart, scalable and user-centric solution that can deliver real-time, context-aware responses to institutional inquiries. The successful integration of a vector database with a large language model via Retrieval-Augmented Generation demonstrates the viability of modern AI techniques in solving real-world challenges within the education sector. The system reduces administrative workload, improves information accessibility and sets a strong precedent for future innovations in institutional support.

## REFERENCES

- Smith, J., & Chen, L. (2023). Advances in Information Retrieval Algorithms. *Journal of Computing and Data Science*, 15(2), 112–130.
- Fernández, R., García, J., & Sánchez, J. (2021). AI-based virtual assistants in Spanish universities: Enhancing the student experience. *Education and Information Technologies*, 26(4), 4071–4089.
- Omorogiuwa O, Gbadegesin D. B. (2023). “A Computerized Student Complaint Management System”, *Journal of Advances in Mathematical Computational Science*, Vol. 11, pg 1 -10.
- Martinez, D., & Ali, F. (2025). Semantic Search and Knowledge Graphs in Academic Retrieval Systems. *Journal of Information Science and Technology*, 39(1), 87–104.
- Zhou, X., Li, H., & Wang, Y. (2023). Improving retrieval effectiveness by addressing term variation in academic search engines. *Information Processing & Management*, 60(1), 102-856.
- Liu, J., & Zhang, M. (2024). Contextual disambiguation of polysemous terms in information retrieval. *Journal of the Association for Information Science and Technology*, 75(2), 125-138.
- Patel, S., Kumar, R., & Mehta, D. (2025). Advances in semantic information retrieval: Bridging the gap between user intent and search results. *IEEE Transactions on Knowledge and Data Engineering*, 37(4), 1012-1025.
- Karpukhin, V., Oguz, B., Min, S., Lewis, P., Wu, L., Edunov, S., ... & Yih, W. (2020). Dense passage retrieval for open-domain question answering. *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 6769–6781.
- Xie, Y., Wu, W., & Deng, Z. (2020). Personalized search in academic IR: Challenges and advances. *Information Processing & Management*, 57(6), 102-120.
- Johnson, M., Patel, R., & Singh, A. (2024). Academic Information Retrieval Systems: Current Trends and Challenges. *International Journal of Digital Libraries*, 29(1), 45–62.
- Hien Luong & Khiet Luong (2025). A Chatbot-Based Academic Advising Model for Student in Information Technology: A Case Study. *Saudi J Eng Technol*, 10(3): 93-100.