

Hybrid Knowledge-Graph-Enhanced Retrieval-Augmented Generation for Academic Information Systems

Zeroth Review

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Abstract

Academic data is typically unstructured and fragmented across institutional websites, limiting the effectiveness of keyword-based and embedding-only retrieval systems. Hybrid knowledge-graph-enhanced retrieval-augmented generation improves contextual grounding and relational reasoning by combining semantic vector retrieval with structured knowledge graph inference, supporting SDG 4 and SDG 9 [1, 2].

Introduction

- Growing dependence on online academic information
- Institutional data scattered across multiple web sources
- Limited relational reasoning in conventional retrieval systems
- Need for intelligent, knowledge-driven academic information systems

Literature Review

Sl.No	Title	Methodology	Results	Limitations
1	Knowledge graph-extended RAG for QA [1]	KG-guided retrieval + LLM	Improved multi-hop accuracy	Requires structured knowledge graph
2	RAG for educational applications [2]	Semantic retrieval + LLM	Reduced hallucination	Dependent on retriever quality

Research Gaps Identified

- Limited use of knowledge graphs in academic RAG systems
- Lack of hybrid vector-graph retrieval pipelines
- Insufficient explainability in LLM-based academic QA

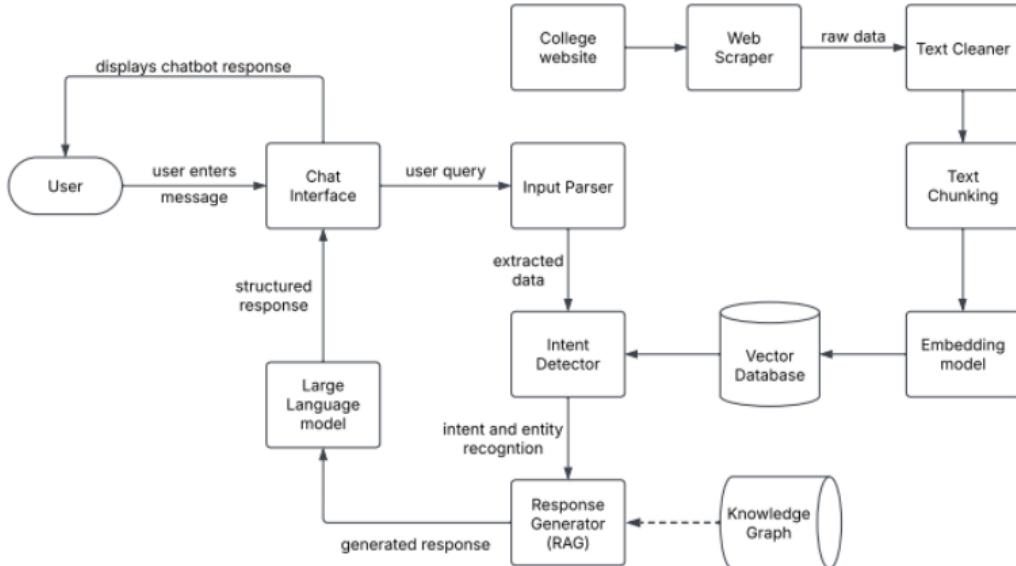
Problem Statement

To develop a hybrid knowledge-graph-enhanced retrieval-augmented generation system for accurate and explainable academic information access.

Objectives

- ① To preprocess and index institutional text using vector embeddings.
- ② To construct a knowledge graph of academic entities for Mar Baselios College of Engineering and Technology.
- ③ To integrate hybrid retrieval for query answering.
- ④ To improve factual grounding and relational reasoning.

Work Flow Diagram



Methodology

- Data scraping, cleaning, and chunking
- Vector embedding
- Knowledge graph construction
- Hybrid retrieval and LLM-based answer generation

Conclusion

- Hybrid KG-RAG improves academic information retrieval
- Supports both semantic and relational queries
- Provides grounded and explainable responses
- Aligned with SDG 4 and SDG 9

References

- [1] J. Linders and J. M. Tomczak, "Knowledge graph-extended retrieval augmented generation for question answering," *Applied Intelligence*, vol. 55, no. 17, pp. 1102–1118, 2025.
- [2] Z. Li, Z. Wang, W. Wang, K. Hung, H. Xie, and F. L. Wang, "Retrieval-augmented generation for educational application: A systematic survey," *Computers and Education: Artificial Intelligence*, vol. 8, p. 100417, 2025.

Thank You