

Survey Paper on Research Scientist Assistant

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Abstract: *The rapid expansion of scientific publications presents growing challenges for researchers who must locate, evaluate, and verify relevant literature across vast databases. To address these needs, Multi-Agent Systems (MAS) and Generative AI (GenAI) are being developed to automate research workflows spanning literature retrieval, summarization, and verification. This survey paper provides an overview of recent studies that integrate these technologies to support researchers. The paper analyses leading architectures, Retrieval-Augmented Generation (RAG) systems, verification tools, and recommendation mechanisms. Findings suggest that while progress is significant, full end-to-end automation remains limited. Future systems must prioritize transparency, explainability, and user-centred design to truly transform research practices.*

Keywords: Generative AI, Literature Discovery, Multi-Agent Systems, Research Automation, Retrieval-Augmented Generation, Scientific Verification

I. INTRODUCTION

The field of academic research has entered an era of information overload, where thousands of new papers appear daily across disciplines. Traditional literature review methods are insufficient to manage this surge, leading to missed insights and slower innovation. Researchers are increasingly turning toward automation using Multi-Agent Systems (MAS) and Generative Artificial Intelligence (GenAI).

MAS architectures distribute research tasks among autonomous agents that can retrieve, summarize, and verify literature simultaneously. Generative models such as Large Language Models (LLMs) provide new capabilities in producing coherent summaries and contextual answers. Combined, these tools have the potential to reshape the research process, transforming literature discovery into a semi-automated, verifiable workflow.

However, despite these advancements, challenges persist in integrating robust verification, maintaining transparency, and supporting user-defined customization. This survey follows the structure and clarity guidelines proposed by Gastel and Day to review the current state, highlight limitations, and identify opportunities for the next generation of AI-driven research assistants.

II. LITERATURE REVIEW

TABLE I: Literature Review Summary

Research Paper Title	Year & Authors	Methodology Adapted	Major Findings
Retrieval-Augmented Generation for Large Language Models: A Survey	2023, Yunfan Gao et al.	RAG established as a key grounding technique for LLMs, highlighting multimodal limitations.	Discusses retrieval strategies, augmentation methods, and evaluation metrics.
Robin: A Multi-Agent System for Automating Scientific Discovery	2025, Ghareeb et al.	Multi-agent workflow integrating literature search, hypothesis generation, and experiment design.	Demonstrates agentic pipelines for automation but stresses human-in-loop verification.



GenoMAS: A Multi-Agent Framework for Scientific Discovery via Code-Driven Gene Expression Analysis	2025, Liu et al.	Domain-specific MAS for genomic data analysis, collaborative programming agents.	Improved performance on genomics benchmarks via typed message-passing and guided planning.
The Need for Verification in AI-Driven Scientific Discovery	2025, Cornelio et al.	Verification pipelines ensuring scientific rigor across data, code, and text.	Highlights limits of current AI verification and urges scalable validation methods.

III. METHODOLOGY

A. Multi-Agent Architectures for Research

Multi-agent systems (MAS) have become a cornerstone for automating research workflows. Ghareeb, Gridach, and Piccialli show that distributing complex subtasks—searching, extraction, comparison, and validation—across cooperating agents produces more accurate and scalable outcomes than single-agent designs. Projects such as Robin and GenoMAS demonstrate end-to-end agentic automation, extending from literature exploration to domain-specific analyses such as gene-expression pipelines.

B. Retrieval-Augmented Generation (RAG) and LLMs

RAG enhances factual accuracy by grounding generated text in verified literature. This improves contextual reasoning and citation traceability but remains limited in multimodal integration. Thus, integrating a RAG core within our proposed Research Scientist Assistant ensures verifiable synthesis.

C. Scientific Verification and Claim Checking

Existing systems largely perform surface-level checks. True verification requires mapping assertions to evidence, citation networks, and consistency checks. Our design embeds a dedicated Verification Agent for claim-to-evidence mapping and human-in-loop validation.

D. Summarization, Recommendation, and Quality Filtering

Tools such as ResearchPal and Litmaps advance summarization and recommendation. However, they lack multi-dimensional quality synthesis. Our framework proposes an Adaptive Recommendation and Quality-Filtering Module combining contextual learning and RAG-based scoring for improved relevance.

IV. DISCUSSION

From the review, it is evident that no existing system comprehensively addresses all research requirements. MAS-based platforms like Robin and GenoMAS excel at distributed task management but need standardized verification and usability improvements. RAG frameworks enhance factual grounding but still lack cross-document claim-checking. Practical tools like Litmaps and ResearchPal assist discovery but fall short in deep verification.

An ideal research assistant should:

- Provide transparent, ranked, and explainable outputs with citations.
- Integrate cross-modal verification (text, tables, figures, code outputs).
- Enable researcher-driven filtering (journal quality, dataset provenance).
- Present structured summaries and reproducible artifacts.

V. CONCLUSION

This survey examined current approaches in Multi-Agent Generative AI for literature discovery and verification. While automation and retrieval synthesis show promise, gaps remain in verification and multimodal integration. Future AI



research assistants must unite MAS orchestration, RAG grounding, and layered verification while maintaining transparency and human oversight.

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