



Atelier: An Agentic AI Framework for Intelligent Research Automation, Scientific Knowledge Discovery and Autonomous Research Assistance

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Abstract: Research includes different processes, for instance, literature review, identification of research gap, selection of methods, citation management, verification of evidence, comparison of articles, and report writing. Due to the importance of these processes, they usually take a lot of time and effort. Various specialized tools have been developed to perform these activities separately, which is why academic research is a lengthy and fragmented process. [2], [5], [6] Currently, there are tools like SciSpace, Elicit, and Semantic Scholar that can be used for discovering articles and gathering information, but again the researcher is left with such tasks as detecting research gap, choosing methods, validating evidence, managing citations, and writing reports. [1], [6], [10] To overcome this problem, this paper presents Atelier, a framework based on the use of the Multi AI agents that help researchers in completing different activities during the research process, namely doing literature searches, managing citations, identifying research gaps, verifying information, comparing different papers, generating methodologies, assessing originality, and writing reports. Atelier has been used to test many research topics, producing literature overviews, identifying research gaps, and providing citation details, comparisons across papers, recommendations of methods, and research drafts. The findings indicate that Atelier is able to integrate different tasks related to research together, minimizing

manual work and engaging researchers in the final process of taking decisions.

Index Terms: Agentic AI, multi-agent systems, research automation, literature review, citation management, research gap identification, evidence verification, knowledge graph, vector database, report generation.

1. Introduction

The academic research process has a very important role in scholarly activities and scientific development. There are different processes which are part of this process. These processes include literature discovery, literature review, finding a research gap, choosing the methodology, citation management, evidence verification, comparing papers, novelty detection, planning the research process and writing the research reports. Although all these processes are very important, they usually take a lot of time and effort. Researchers usually use different tools for different research purposes and organize the data they gather manually, thus creating a fragmented research process [2], [5], [8]. There are some new developments in the area of Artificial Intelligence (AI), including Large Language Models (LLMs) and agentic AI. These developments make it possible to assist and automatize several research processes [2]. Multi-agent systems

allow different specialized agents to execute different tasks and coordinate their work within a process, rather than using one model [2]. There are some studies, such as LiRA, that show how it is possible to use multiple agents in order to create a clear literature review process [1].

There are also some possibilities to use retrieval-augmented generation systems that will be able to combine methods of retrieval, knowledge graphs, vector database, and reasoning in order to gain access to relevant information and make responses more context-based [3],[4],[13]. There are some examples of specialized agents that are able to collaborate in the processes of literature synthesis, research planning, writing, and science discovery - e.g., Agent Laboratory, PaperOrchestra, MetaGPT, AutoSurvey, SciAgents, and DORA [10], [11], [15]. Nevertheless, there are many research-supporting tools that concentrate on particular steps of research - paper discovery, information retrieval or summarization. There are also many helpful tools like SciSpace, Elicit, Semantic Scholar that assist with literature discovery and information extraction, but other steps, such as research gap analysis, methodology selection, evidence verification, citation management, and report writing might need another set of tools or researcher's help. Atelier is an agentic AI system which is introduced to tackle this fragmentation in research workflow process. It employs multiple specialized AI agents for performing coordination of tasks needed for conducting literature review, analyzing papers, identifying research gaps, suggesting methodologies, citing sources, verifying evidence, assessing the novelty, planning research, conversing and writing reports. The main goal of Atelier is to consolidate these research processes in one single framework and minimize the effort required for managing information in a disjointed manner. Atelier is based on multi-agent systems, agentic RAG models, and end-to-end AI research frameworks [2], [3]. The rest of this paper talks about the related work and research gap that has been found, the methodology that has been used, system architecture, workflow of agents, results and observations, discussion, and finally conclusion.

2.LITERATURE REVIEW

2.1 Existing Tools and Methodologies

The discovery of documents, literature review, analysis of other researchers' work, citation management, and other related actions by the researchers involve a variety of instruments. Some

effective instruments used to locate, read, and process the literature include SciSpace, Semantic Scholar, and Elicit. Newer research has become reliant on the utilization of multi-agent systems, agent-based RAG, and knowledge graphs among many others [2], [3], [4], [13]. These methods bring along reduction of manual efforts and improvement of literature search process [1]. However, the majority of available assets work on separate issues leading researchers to use various instruments and do intellectual synthesis of documents manually [1], [2], [5], [6]. Such scenario reveals the necessity of the idea of creating the Atelier platform.

2.2 Related Research Papers

There are some researchers conducted on the role of agents in academic research [1], [2], [5]-[11], [15]. In particular, the research work entitled "Can Agents Judge Systematic Reviews Like Humans?" uses several agents for assessing the efficiency of systematic literature review [7]. At the same time, PaperOrchestra utilizes different kinds of agents for helping researchers in doing literature reviews, references validation, papers writing and papers improvements [8]. Some other papers, like LiRA, AutoSurvey and SciAgents, study the abilities of agents in literature searching, researching ideas generation [1], [10], [11]. Such researches show that the application of several advanced agents can significantly decrease the number of human efforts and help in conducting the research in general [1], [5], [6], [8], [10] Atelier expands these research efforts through developing one tool which will incorporate all necessary research-supporting tasks like literature reviews, research gap identification, evidence and methodologies validation, comparison of papers and report generating.

2.3 Research Gap

As seen from the existing literature, there is an ample use of AI and multi-agent systems in various activities associated with academic research. For example, LiRA is designed to produce reliable and coherent literature reviews whereas Agent Laboratory uses LLM agents in order to assist in research activities [1], [5]. PaperOrchestra and AutoSurvey specialize in automated research paper and survey generation [8], [10]. There are also some research efforts devoted to systematic literature review by means of multiple AI agents, systematic reviews evaluation and multi-agent methods for scientific discoveries [6], [7], [12]. There are Agentic RAG and Graph RAG approaches which demonstrate the applicability of knowledge graphs,

vector-based retrieval and reasoning to organize and retrieve the research information [3],[4],[13]. However, existing approaches primarily concentrate on certain research activities or selected phases of the academic research process. Such research-related activities as literature search and review, research gap identification, paper comparison, evidence check, methodology recommendation, citation management, novelty check, research planning and report writing are generally not combined in one unified research support system. As a result, researchers may be required to employ a number of tools and to combine the information manually.

Thus, there is a demand for such a unified agentic AI approach which will allow researchers to coordinate specialized agents for various research activities while remaining in charge of decision making. Atelier is meant to solve this problem by uniting all research helpers on one platform and supporting the researcher throughout the academic research process.

2.4 Problem Statement

Researching is not as easy as it looks. Finding papers to read for the literature review, determining the research gaps, comparing articles, confirming the facts, determining the methodology, handling the citations, and then writing the report turns into a lengthy process. [6], [8], [10] The problem is that different tools are needed for every procedure, so a rather swift and seamless process gets complicated. [2], [5], [6] Most AI research tools available today concentrate on limited functions—some specialize in finding papers and others are experts in summarizing. [1], [6], [10] There is no single solution that will cover all steps. Because of that scientists have to collect, organize and process the information manually while constantly switching from one application to another. [2], [5], [6] Atelier was created to meet these challenges. It uses several AI applications for literature reviews, creating citations, finding research gaps, suggesting methodologies, verifying the data, and comparing articles, while one of the applications is aimed at writing the final report.

2.5 Objective of Research Paper

The research's ultimate goal is creating an agentic AI-related method called 'Atelier' to guide the user in the entire field of academic investigation on just one platform. The method aims at saving time and effort in many processes, including literature review, writing of papers, spotting of research gaps, identification of the

method used, management of references, verification of findings, planning of the research, and compilation of reports. Atelier is not only about that; it has the objective of incorporating various specialized AI agents that will work together and provide the user with proper research assistance.

3. PROPOSED METHODOLOGY AND SYSTEM ARCHITECTURE

3.1 Overall Methodology

Atelier has been developed to offer centralized assistance in the various activities of academic research. It is equipped with specialized AI assistants which perform different tasks; thereby assisting researchers at all stages of their work. The principal assistances perform the operations of searching and reviewing literature, managing citations, detecting gaps in research, checking for evidence, comparing academic papers, providing advice on researches, evaluating novelty, creating research proposals, writing reports, and conducting conversations. Each assistant performs its task and communicates the necessary information with other assistants.

The process starts when the researcher inputs the subject area and the question. The system divides the task into smaller tasks and assigns each operation to the relevant assistant. The knowledge base structure is built in such a way as to be capable of storing, linking, and retrieving data [13]. Throughout the entire process, the researchers have opportunity to review results, receive feedback, and propose modifications. Consequently, the system updates its output accordingly and the researcher enjoys the ability to exercise decision-making right at every stage of the research. Atelier is constituted of Python, various open-source libraries, large language models (LLMs), knowledge bases, and vector bases - meeting the simplicity of its web interface. As it has been said above, Atelier is intended to combine several research activities in a single platform while having the researcher in the center of the process.

3.2 System Architecture

The system architecture of Atelier includes a set of components working together to assist with the academic research process. The interaction between the researcher and the system takes place in the Web Application component, where the research question is inputted and the results required are delivered to the user. The Application Layer includes the Research

Workflow and AI Processing components. Research Workflow controls the research tasks and coordinates the specialized AI assistants, and AI Processing conducts the research activities according to the assigned tasks. The Research Papers and Online Sources may be the external sources from which the relevant information for conducting the research is collected.

The Knowledge and Data Layer includes such components as Knowledge Base, Vector Database, and Project Database. Knowledge Base holds the vital information needed for the research, Vector Database assists in efficient searching for the relevant or similar information, and Project Database controls the information related to the research project itself. All these components help organize the information used in the research process. The components are connected through the research workflow to provide the transfer of information from the external sources, AI processing, and data layer. The results are provided to the researcher via the Web Application component. Thus, this architecture presents a centralized approach to conducting different research processes with the involvement of the researcher in the process.

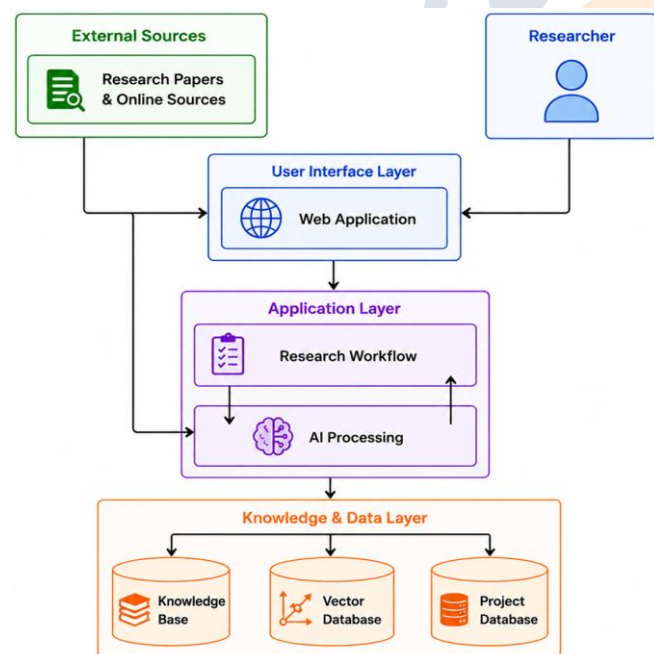


Fig. 3.2.1. Atelier – System Architecture

3.3 System Workflow

Atelier working process involves the following stages. After entering the research topic or question into the web application by the researcher, the system analyses this information and splits the research requirement into smaller tasks. Then, these tasks are allocated to the

respective specialized AI agents depending on their role. Then the AI agents collect and process the required information from research papers and Internet sources. The information is structured by the Knowledge Base, Vector Database, and Project Database and allows the agents to use the necessary information in the course of research. Also, the agents can exchange the required information between themselves for the sake of connected research activities. Having processed the assigned tasks, the system presents the results of this work to the researcher via the web application. The researcher examines the results, provides feedback and requests changes where it is necessary. With the help of researcher's instructions, the outputs may be improved prior to creating the research report.

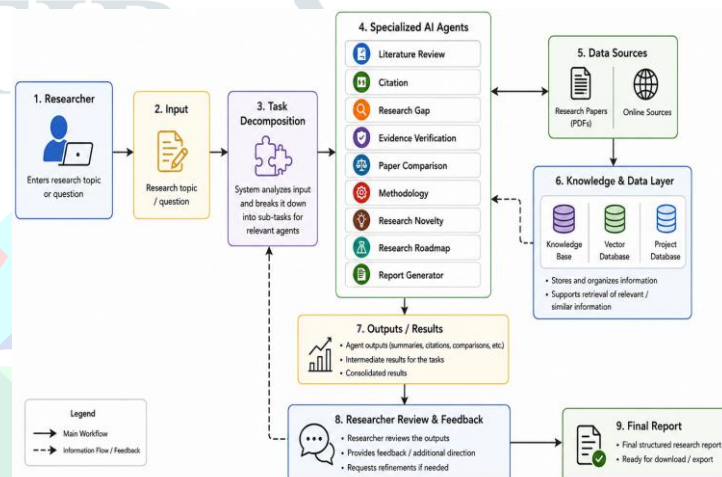


Fig. 3.3.1 Atelier – System Workflow

3.4 Agent Roles and Responsibilities

Table 3.4.1 presents the roles and responsibilities of the specialized AI agents used in the Atelier framework.

Table 3.4.1: Agent Roles and Responsibilities

AI Agent	Main Responsibility
Literature Review	Reads PDFs and extracts summaries, keywords, objectives, findings, and limitations.
Citation	Generates APA, IEEE, and BibTeX entries from the literature.
Research Gap	Compares papers and identifies unexplored areas and novelty
Evidence Verification	Grounds key claims in a paper, page, and supporting snippet.

Paper Comparison	Builds a side-by-side comparison matrix across uploaded papers.
Methodology	Recommends algorithms, datasets, tools, and evaluation metrics.
Research Novelty	Provides AI-assisted assessment of the novelty of a new research direction.
Research Roadmap	Generates a phased roadmap from literature review to paper writing.
Report Generator	Compiles the generated outputs into a structured research report.

4. RESULTS AND OBSERVATIONS

In the Atelier system, several specialized AI agents are integrated for performing various research activities at different stages of the research process. Depending on the topic and research question, the Atelier system assigns the respective tasks to the specialized agents. These tasks include literature reviews, research gaps identification, citation generation, article comparisons, methodology suggestions, assessing the research novelty, generating research outlines and preparing reports. The outputs created from different specialized agents are integrated into the Atelier system. Thus, the researchers are not required to perform the research activities individually. Moreover, the Conversational Helper agent is available to answer questions related to the information that has been collected. Thus, the system helps in minimizing the manual efforts involved in collecting and organizing the information for academic research. Some of the activities that include literature reviews, research gap identification, article comparison, citation management, method suggestions and report preparation are performed with the help of different specialized research agents. However, the information and the outputs created in the Atelier system are supposed to be reviewed by a human researcher. The researcher should verify the information and the sources used for analyzing the information.

5. DISCUSSION

The Atelier platform integrates several key features for performing academic research into one system. By leveraging the abilities of special AI assistants, the system aims to minimize the use of several different applications and to simplify the entire process of

research to some extent. It can assist in various routine tasks that include performing literature review, comparing papers, referencing materials and making reports. The produced outputs, which involve literature summaries, research gaps, comparison of papers and draft reports, will be helpful for researchers at each stage of research work. The citation assistant and Conversational Helper will additionally make the use of the system more convenient for researchers. Thus, researchers will be able to concentrate more on analysis and development of their own ideas rather than on searching for information.

At the same time, there are some disadvantages in Atelier. Its efficiency largely depends on the quality and amount of information from its knowledge sources. Therefore, researchers will probably need to check the accuracy of literature summaries, research gaps, citations and other outputs. Most of the available tools concentrate mainly on either finding papers or summarizing them [1], [6], [10], while Atelier brings together many research-related functions into one solution. Nevertheless, information generated by the artificial intelligence cannot substitute researcher's judgement and needs to be confirmed prior to using it in scholarly papers. Possible improvements might involve adding more data to the knowledge base, improving the process of evidence validation, as well as adding support for other research areas.

6. CONCLUSION

This article introduces an agentic AI-based system called Atelier that aims to provide assistance in different elements of academic research using one single platform. The platform contains AI agents that assist in processes like literature review, finding gaps in research, comparing papers, suggesting methodologies, citing sources, validating evidence, assessing novelty of research, planning for research, and preparing reports. With the help of these research activities provided by one single platform, Atelier tries to avoid the inconvenience of shifting from one tool to another, thus making the entire process of research simpler. The literature reviews, research gap analyses, comparing papers, citation assistance, suggestion of methodology, and draft reports prepared through Atelier can be helpful for researchers at different points in their research process. Additionally, Conversation Helper makes things easier by enabling researchers to ask any queries concerning their research.

Although Atelier is useful, it cannot take the place of the human researcher. It is because the quality of generated materials depends on the availability of information, which means that the researcher should confirm the source and information and edit the generated material before utilizing it in scholarly papers. Possible developments in future might include development of the knowledge base, evidence verification, more research areas, as well as the possibility to get feedback from the researcher. In general, Atelier is an integrated multi-agent framework for managing academic research.

7. REFERENCES

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