

Towards the Use of AI-Based Tools for Systematic Literature Review

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Abstract: The constant growth in the number of published research studies and their rapid rate of publication creates a significant challenge in identifying relevant studies for unbiased systematic reviews. To address this challenge, artificial intelligence (AI) methods have been used since 2016 to improve the efficiency of scientific review and synthesis. Nevertheless, the growth in the number of AI-powered tools dedicated to processing text-based data has been remarkable since the introduction of generative pre-trained transformers by OpenAI in late 2022. Moreover, alongside this development, ChatGPT, a language model that provides a user-friendly chatbot interface, was introduced. The incorporation of this interactive feature has greatly enhanced the capability of developers and end-users alike to effectively utilize and access ChatGPT. This study aims to investigate the effectiveness of six AI-based tools namely Chatpdf, Pdf2gpt, Hipdf, SciSpace, Easy-peasy AI, and DocAnalyzer AI, developed utilizing ChatGPT technology. These tools will be evaluated in a specific scenario where they are automated to carry out a particular step within a Systematic Literature Review. Furthermore, the limitations associated with each tool will be analyzed, and strategies will be proposed to overcome them. Additionally, this study aims to provide recommendations for researchers who intend to incorporate these tools into their research processes.

1 INTRODUCTION

Artificial Intelligence (AI) is an expansive and interdisciplinary field that integrates principles from computer science and linguistics to develop computers capable of performing tasks typically reliant on human intelligence (Sarker, 2022). Furthermore, in recent studies conducted by various researchers (Yang et al., 2023; Verma, 2023; Zhu et al., 2023), the increasing significance of utilizing AI in research has been recognized. Researchers have come to acknowledge the value and effectiveness of AI as a valuable tool for data analysis and literature review. The systematic integration of AI into scientific research processes can effectively enhance their efficiency. While still nascent in development, AI has already showcased considerable potential which could potentially revolutionize research methodologies significantly, particularly within the realm of non-coding applications (Calo, 2017). As we explore the increasing capabilities of artificial intelligence, it is evident that possessing deep technical skills is no longer a necessity for leveraging AI to advance and enhance research. One significant advancement in natural language processing is OpenAI's Generative Pre-Trained Trans-

former (GPT), which demonstrates remarkable innovation (Yenduri et al., 2023). GPT has been extensively trained on large amounts of text data, allowing it to effectively use flexible language skills similar to human communication. By utilizing GPT's core abilities, tasks like chatbot programming and modern translation tools can greatly benefit from its exceptional ability to create complex language nuances. Moreover, this model can be fine-tuned for various language-related tasks, including but not limited to language translation, text summarization, and text enhancement (Hassani and Silva, 2023). The most recent iteration of the model, GPT-3, exhibits superior performance compared to its predecessors, making it highly suitable for the dynamic field of natural language processing. On November 30, 2022, OpenAI introduced an AI-driven conversational agent called ChatGPT (George and George, 2023). This announcement sparked great interest among experts and researchers in artificial intelligence, leading them to thoroughly assess and scrutinize the program's abilities. Furthermore, researchers have shown great interest in the launch of ChatGPT because they are eager to explore and experiment with this cutting-edge technology across various industries. As a result, there

has been significant research conducted to examine the wide array of potential applications where ChatGPT can be effectively employed (Ray, 2023; Sallam, 2023). In a study conducted by Patel et al. (Patel and Lam, 2023), the researchers examined how ChatGPT could be utilized to produce hospital discharge summaries in response to quick queries. The findings showed that ChatGPT was proficient at swiftly generating comprehensive summaries, offering the potential to decrease delays in patient discharges within primary care settings while still preserving an appropriate level of detail. This automated process enables physicians to allocate more time towards patient care and education tasks. Furthermore, in the study of (Jeblick et al., 2022) the researchers examined ChatGPT's effectiveness in streamlining radiology reports with favorable outcomes. The generated reports were highly technical and provided a comprehensive overview with low perceived risks for patients. However, both studies also highlighted some instances of inaccuracies within the system. In the case of the patient discharge summary, ChatGPT added additional information that the authors haven't requested (Patel and Lam, 2023). Similarly, the analysis of radiology reports revealed potentially dangerous omissions, such as the omission of important medical findings. These shortcomings suggest that a manual review of the automated results would be necessary if the system were to be implemented in clinical practice (Jeblick et al., 2022). Conversely, findings from a study conducted by the European Patent Office indicate that around 30% of research and development investments are squandered as a result of reworking existing literature (Harhoff and Wagner, 2009). This underscores the significance of incorporating pertinent scholarly papers when preparing grant proposals for funding organizations like the National Science Foundation and the National Institutes of Health. Failure to provide pertinent literature can result in proposal rejection. In traditional survey and review articles, there is often a lack of systematic coverage of all published work within a particular field. Moreover, basing new project concepts solely on these articles can be misleading. To address these concerns, various techniques have been developed, one being conducting a systematic literature review (SLR) (Snyder, 2019). An SLR employs a methodology that identifies, evaluates, and synthesizes all available research about a specific research question or topic area (Snyder, 2019). The goal of an SLR is to provide a trustworthy method for obtaining accurate, appropriate, and unbiased information about a research topic (Gurbuz and Tekinerdogan, 2018). The previously mentioned procedure provides a robust framework for the

Table 1: The steps of a systematic literature review (Keele et al., 2007).

ID	Category	Step
SLR1	Need for a review	Commissioning a review
SLR2		Specifying the research question(s)
SLR3		Developing a review protocol
SLR4		Evaluating the review protocol
SLR5	Conducting the review	Identification of research
SLR6		Selection of primary studies
SLR7		Study quality assessment
SLR8		Data extraction and monitoring
SLR9		Data synthesis
SLR10	Reporting the review	Specifying dissemination mechanisms
SLR11		Formatting the main report
SLR12		Evaluating the report

methodical and unbiased examination of relevant literature, with a strong emphasis on accuracy. Since 2007, systematic reviews as introduced by keele et al. (Keele et al., 2007) have been widely used in the area of software engineering. Nevertheless, the process of collecting, extracting, and synthesizing the data required for systematic reviews is recognized as challenging, error-prone, and labor-intensive in several domains such as software engineering and medicine (Marshall et al., 2016). It is generally known that it takes more than one year from the last search to publication for an SLR study, and 2.5 – 6.5 years for a primary study to be included in an SLR study (Jonnalagadda et al., 2015; Elliott et al., 2014). In addition, 23% of all SLR studies have become outdated within 2 years of publication because reviewers fail to include new evidence in their areas of interest (van Dinter et al., 2021). However, The steps in the systematic review method are listed in Table 1 according to (Keele et al., 2007).

According to Van Dinter et al. (van Dinter et al., 2021), numerous research papers admit that one of the main purposes behind automating systematic reviews is to lessen the financial burden linked with conducting these evaluations. Our research focuses on exploring the application of AI-based methods to automate the selection of primary studies during the SLR6 step, as illustrated in Table 1.

The subsequent sections of the paper are structured as follows. In Section 2, an examination of previous studies is presented. The tools used throughout this research are defined in Section 3. Section 4 outlines our conducted tests and presents the corresponding results. Finally, in Section 5, we draw conclusions from our findings and identify potential avenues for further investigation in future research endeavors.

2 RELATED WORK

In this section, we will present some relevant studies that have been conducted to automate the steps of SLR from a table 1. The procedure of selecting primary studies to conduct a systematic literature review, commonly known as SLR6, has frequently been automated. This is primarily attributed to the consensus among researchers that this step is exceedingly laborious (Bannach-Brown et al., 2019; Sellak et al., 2015; Tsafnat et al., 2018).

Several studies, such as (Mergel et al., 2015; Scells et al., 2020; Scells et al., 2019), have highlighted the automation of identifying research (SLR5), particularly in creating the search query for a systematic literature review, as one of the most automated steps in scholarly literature. This indicates that formulating a search query for a systematic review presents a considerable challenge.

To maximize the inclusion of relevant studies (Biolchini et al., 2005) while excluding irrelevant ones (Scells et al., 2019), researchers endeavor to establish explicit criteria for their study. These criteria serve as a basis for selecting articles that meet specific requirements and are eligible for review. In his research, (Felizardo et al., 2012) presents a novel method that utilizes decision tree-based approach to automatically generate queries in the field of legal eDiscovery. Similar to other conceptual and objective approaches, this innovative technique relies on initial studies as references to determine the keywords and their appropriate placement within the query. However, using this methodology for literature searches during systematic reviews poses a challenge as it necessitates including a considerably larger number of seed studies than what is typically feasible. Conversely, leveraging techniques like machine learning and natural language processing can greatly enhance and automate the systematic review process. Furthermore, Ghafari et al. (Ghafari et al., 2012) made a significant contribution by introducing a federated search tool that offers an automated integrated search function across major databases in the field of Software Engineering. The findings of the case study evince that their

approach not only diminishes the time required to perform SLR and simplifies its search process, but also enhances its dependability and leads to an upward trend in the utilization of SLRs. In their research, (Hannousse and Yahiouche, 2022) introduced a unique strategy for creating a partially automated system to reduce the manual labor required for paper processing. This novel approach combines unsupervised and semi-supervised machine learning models, effectively using both approaches' strengths. Additionally, this system makes use of a domain ontology to improve accuracy and efficiency. Felizardo et al. (Felizardo et al., 2012) conducted a study in which they mechanized the assessment of the selection of primary studies. These studies were identified as the sole studies carrying out a study quality assessment, known as SLR7. The authors delineate that the process of conducting a review comprises two steps, namely selection execution and information extraction. The selection execution phase is further divided into three sub-steps, with the last one, namely the selection review step, being the primary focus of their study, i.e., the study quality assessment step, SLR7. The authors highlight that reviewers may perform this step by employing quality criteria to ensure that relevant studies are not excluded prematurely if required. Finally, the automation of the Data extraction and monitoring step (SLR8) has been implemented in five studies. The underlying reason for automating this step is that the data extraction process is commonly a labor-intensive task (Aliyu et al., 2018; Elamin et al., 2009). Studies have indicated a significant incidence of inaccuracies in the manual data extraction process, which can be attributed to human-related aspects such as insufficient time and resources, inconsistencies, and blunders resulting from monotony. It is important to highlight that our investigation revealed a lack of previous research on the utilization of GPT-based tools for automating systematic literature reviews. As such, our study seeks to address this gap by examining the feasibility and potential benefits of employing GPT-based tools in automating SLRs.

3 BASIC CONCEPTS

In this section, we provide a comprehensive definition of the chosen tools along with an examination of their functionalities and limitations. It should be noted that a detailed technical analysis was not possible due to the lack of information available on either the official websites or in existing literature.

3.1 Chatpdf

Chatpdf is a platform that is powered by advanced artificial intelligence technology. It facilitates users to effectively and proficiently extract information from voluminous PDF files, which may include research papers, books, etc. (ToolsPedia.io, 2023). The two main access options for Chatpdf are:

- **Free Access:**
 - 120 Pages/PDF
 - 10 MB/PDF
 - 3 PDFs/day
 - 50 Questions/day
- **Paid Access: (\$5/month)**
 - 2,000 Pages/PDF
 - 32 MB/PDF
 - 50 PDFs/day
 - 1000 Questions/day

3.2 Pdf2gpt

Pdf2gpt is a novel artificial intelligence tool specifically designed to extract information from long PDF documents using the Generative Pre-trained Transformer (GPT) model. It is designed to simplify the process of extracting important data and key points from long PDF documents, allowing users to understand the core content without having to go through the entire document. The interface is user-friendly and allows users to either upload the PDF file or provide the URL for summarization, providing easy access to the tool's features (Theresanaiforthat, 2023). Basically, Pdf2gpt offers two access options:

- **Free Access:**
 - 15 Pages/PDF
 - 40 MB/PDF
 - 7500 Words/pdf
 - The user can access two lengthy PDFs for free by connecting to their account. Each account has the option to obtain one instance of this offer.
- **Paid Access: (\$5/month)**
 - 200 Pages/PDF
 - 40 MB/PDF
 - 75000 Words/pdf

3.3 Hipdf

Hipdf offers a convenient and cost-free method for generating brief overviews of PDF documents. One

notable feature is "Chat with PDF," which employs ChatGPT technology to efficiently condense a document by producing synopses, highlighting key sections and keywords, fostering effortless comprehension. This presents an optimal approach towards enriching the educational process, elucidating intricate ideas, acquiring fresh perspectives, and summarizing lengthy textbooks. (wondershare, 2023). Basically, there are two ways to access Hipdf:

- **Free Access:**
 - 100 Pages/PDF
 - 5 Batch Processing
 - All PDF tools except OCR
- **Paid Access: (\$5/month)**
 - 2,000 Pages/PDF
 - Desktop applications
 - Access to all features, including OCR & AI tools
 - No Batch Processing limit
 - No adverts.

3.4 SciSpace

The SciSpace platform, according to Khan et al. (Khan et al., 2019), provides a comprehensive view of data shared across many geographically dispersed High-Performance Computing (HPC) data centers through a single workspace that facilitates direct data access to achieve optimal performance when reading or writing data within the appropriate data center namespace. The effectiveness of this approach is determined by the use of real scientific datasets and applications. The platform offers a comprehensive, searchable database of more than 270 million scientific papers, authors, subjects, journals, and conferences (theresanaiforthat, 2023). There are no limitations on the usage of SciSpace, except for a maximum file size limit of 100 MB. Additionally, it is available free of charge.

3.5 Easy-Peasy AI

Easy-peasy AI is an AI-powered content assistant that helps users create original and polished content quickly. With a significant 10x increase in speed, the software provides more than 80 AI copywriting templates to assist in creating compelling and professional content. It also includes tools for generating AI images and transcribing audio accurately and efficiently (theresanaiforthat, 2023). The platform features a chatbot called "Chat with MARKy" which offers simple PDF manipulation capabilities. During

Table 2: Comparison of all the tools in general.

Tools	Limits	Other function	Payment
Chatpdf	Pages -Pdfs	None	monthly
Pdf2gpt	Pages	None	monthly
Hipdf	Pages -Tokens	Pdf and Image tools	monthly Yearly
SciSpace	None	Literature review-Paraphrase	None
Easy-peasy AI	Pages	AI Transcription-Templates	monthly Yearly
DocAnalyzer AI	number of Pdfs	None	monthly Yearly

our testing process, we found that there were limitations when uploading large PDF files (e.g., a 400-page PDF). However, there are no restrictions on the number or size of PDFs other than exclusive access to GPT4 for premium customers only.

3.6 DocAnalyzer AI

DocAnalyzer AI is an intelligent tool that provides interactive and contextually aware functionality when working with PDF files. It utilizes cutting-edge AI techniques to analyze documents effectively and promptly respond to user inquiries. The system thoroughly understands the questions asked and delivers accurate answers without any delay. Its user interface is uncomplicated, private, and continuously improving.

- **Free Access:**
 - 3 PDFs/day
 - Automatically deleted documents after 7 days of inactivity
- **Paid Access: (\$5/month)**
 - No limit on daily uploads
 - Without daily question limitations (up to 10,000)
 - 50 MB/PDF
 - 1 GB storage

In summary, the key differences between the 6 tools are illustrated in Table 2.

Table 3: Research query result.

Database	SLR1	SLR5
(1)-Springer	361	207
(2)-ScienceDirect	902	660
(3)-ACM	98	46
(4)-WebofScience	3	3
(5)-IEEE Xplore	74	70
Total	1438	986

4 EXPERIMENTS

4.1 Context

In the given context, we conducted a thorough investigation called a Systematic Literature Review to examine how Mobile Edge Computing impacts Quality of Service in the domain of 5G. Our research query was thoughtfully devised prior to conducting an extensive exploration using five well-regarded databases: Springer, ScienceDirect, ACM, WebofScience, and IEEE Xplore. The findings are succinctly displayed in Table 3, revealing that a comprehensive evaluation yielded 1438 articles. This thorough analysis seeks to provide valuable perspectives and make a substantial contribution to the current scholarly discourse on this subject. Conducting these initial steps is crucial for ensuring a comprehensive research process. Based on the data presented in Table 3, there has been a notable decrease in the number of articles from the initial step (SLR1) outlined in Table 1 to SLR5, although it is still significant.

Once we finished the initial three stages of exclusion (namely eliminating duplicates, surveys, and inaccessible articles), our attention turned to creating separate PDF files for each database. These documents contain all the abstracts that remained after undergoing previous elimination rounds. The databases involved in this process are listed below along with the number of abstracts and pages associated with them: Springer (207/127 pages), ScienceDirect (660/440 pages), ACM (46/29 pages), WebofScience (2/2 pages), and IEEE Xplore (70/46). In collaboration with an expert, we proceeded to execute the fourth step and acquired results for each database. Subsequently, during this phase, all the tools at our disposal were utilized to compare their respective outcomes with the findings of our expert collaborators. Our initial testing involved utilizing a query that incorporates all the predetermined keywords from our systematic literature review:

- **Q1.** Name all abstracts, without explanation, that related to one of the following keywords:

”QoS AND 5G AND service deployment models AND energy efficiency constraints” OR ”QoS AND 5G AND service orchestration models AND energy efficiency constraints”

The selected tools yielded no results for the query. It is possible that the lack of results is due to the difficulty in finding a single abstract containing all specified keywords. This suggests that these keyword combinations are not commonly found together, making it challenging to find relevant articles on this topic. To increase our chances, we decided to divide the query into two sub-queries focused on different keywords using the ”OR” operation. The new queries are:

- **Q2.** Name all abstracts, without explanation, that related to one of the following keywords: ”5G AND QoS service deployment models AND energy efficiency constraints”
- **Q3.** Name all abstracts, without explanation, that related to one of the following keywords: ”5G AND QoS service orchestration models AND energy efficiency constraints”

4.2 Results and Discussion

In this section, we will explore the results obtained from employing six selected tools to handle all of the PDFs. Moreover, any significant observations made during this implementation stage will be highlighted. Additionally, an assessment will be provided that delineates both the advantages and disadvantages associated with each of these six tools. Table 4 illustrates the first execution of all the queries. Please note that if an article appears in both queries, it will be treated as one instance and counted only once.

From Table 4 we can present some points:

- When it comes to the WebofScience database, all the tools produce the same findings.
- In contrast to the findings in WebofScience, it is evident that ScienceDirect presents a noticeably wider gap in the results obtained from Pdf2gpt and DocAnalyzer AI. This difference can be explained by the fact that Pdf2gpt benefits from smaller PDF documents, which meets its limited requirements and allows for optimal performance.

We have compiled a few key points from the tables above:

- The results from the expert and the tool were mostly similar based on Table 4, with Springer being a notable exception. However, further analysis in Table 5 for ACM and Table 6 for Springer revealed differences between Pdf2gpt’s output and the expert selection. For example, while Pdf2gpt

identified 34 articles from Springer according to Table 4, the expert selected a total of only 69 articles. The intersection between their selections was even smaller at just 16 articles as shown in Table 6. This finding suggests that while the search yielded a large number of results, there is still a notable difference between them. This emphasizes the importance of thorough evaluation and validation when employing automated tools in research.

- Next, we can now compare the results from each database. Starting with ACM, Table 5 presents the overlaps in our tool’s outcomes. From Table 5, it becomes apparent that only three articles are present across all of the results. These articles are: (Maleki et al., 2021; Sharma et al., 2022; Sun and Naser, 2018). We move now to Springer, Table 6 presents the overlaps in our tool’s outcomes. Similar to ACM, Springer also showed 4 articles in all search results. these articles are: (Patel et al., 2021; Velrajan and Ceronmani Sharmila, 2023; Thantharate and Beard, 2023; Kibalya et al., 2023).

4.2.1 Advantages

the main advantages of this approach are:

- To enhance the effectiveness of the expert’s task, it is recommended to minimize the time consumed during this phase. To be more precise, rather than going through a total of 848 abstracts in our specific scenario, it would be sufficient to examine and validate only 640 abstracts instead. While this difference may not appear substantial at first when conducting an initial examination, it becomes increasingly evident as we advance toward the final evaluation.
- The results attained from the deployment of artificial intelligence (AI)-driven technologies have demonstrated a significant degree of efficacy in relation to precision and efficiency. These cutting-edge technological solutions not only furnish rapid outcomes but also guarantee a considerable level of exactitude when conveying reliable information or carrying out specialized assignments.

4.2.2 Limitations

the main problems of the use of AI-based tools are:

- The processing of PDF documents sometimes consumes a significant amount of time. One notable issue arose when we faced difficulties with the page count, necessitating the need to divide these PDFs into multiple sections. It was crucial

Table 4: Result of the first execution.

Tool/Database	Springer	ScienceDirect	ACM	WebofScience	IEEE Xplore	Total
Chatpdf	7	24	6	0	7	44
Pdf2gpt	34	115	11	0	12	172
Hipdf	14	32	5	0	10	61
SciSpace	14	99	9	0	8	130
Easy-peasy AI	11	51	7	0	7	76
DocAnalyzer AI	7	31	8	0	6	52
Human Expert	69	81	13	0	9	172

Table 5: Common selected paper for ACM.

	Chatpdf	Pdf2gpt	Hipdf	SciSpace	Easy-peasy AI	DocAnalyzer AI	Human Expert
Chatpdf	*	5	4	5	3	4	5
Pdf2gpt	5	*	5	7	5	6	8
Hipdf	4	5	*	4	4	3	4
SciSpace	5	7	4	*	6	7	8
Easy-peasy AI	3	5	4	6	*	5	6
DocAnalyzer AI	4	6	3	7	5	*	5
Human Expert	5	8	4	8	6	5	*

Table 6: Common selected paper for Springer.

	Chatpdf	Pdf2gpt	Hipdf	SciSpace	Easy-peasy AI	DocAnalyzer AI	Human Expert
Chatpdf	*	6	5	7	6	6	5
Pdf2gpt	6	*	11	9	6	5	16
Hipdf	5	11	*	10	7	5	6
SciSpace	7	9	10	*	4	5	7
Easy-peasy AI	6	6	7	4	*	6	6
DocAnalyzer AI	6	5	5	5	6	*	5
Human Expert	5	16	6	7	6	5	*

to ensure that no abstracts were inadvertently separated during this partitioning process. Moreover, a substantial portion of time was expended while subsequently searching through the documents, particularly on platforms such as ScienceDirect and Pdf2gpt.

- In response to the issue we faced regarding the restricted daily PDF limit, we devised two alternative approaches for each tool. While attempting to resolve the problem encountered with Chatpdf, it became apparent that switching devices did not rectify the persistent issue. Consequently, to overcome this challenge, we opted to alter our network connection by transitioning from one router to another.

Conversely, when confronted with a similar obstacle while using DocAnalyzer AI, we successfully resolved it by simply logging into different accounts whenever we reached the predetermined PDF limit.

- When faced with a restriction, Hipdf employs various strategies to address the issue. For instance, when dealing specifically with ScienceDirect PDFs, our approach involves dividing them into smaller files through the process of splitting. Additionally, in situations where users reach their Token limit per user, we collaborate with another account as an alternative solution.
- A recent observation has brought to light the fact

that several tools, including Hipdf, DocAnalyzer AI, and SciSpace, frequently yield inaccurate results. This discrepancy is especially noticeable when the title of the PDF document is missing.

5 CONCLUSIONS

In our research, we examined the utilization of six artificial intelligence-based tools named Chatpdf, Pdf2gpt, Hipdf, SciSpace, Easy-peasy AI and DocAnalyzer AI to automate a specific stage in composing the semantic literature review. We provide comprehensive results from each test conducted and highlight both the advantages and disadvantages associated with utilizing these tools. Additionally, we discuss the limitations inherent in each tool and propose effective approaches for overcoming them. The drawback of utilizing these methods is that they typically necessitate pre-processing, like in our scenario, the splitting of PDF files, etc.

In future investigations related to conducting SLRs, our immediate goal is to complete the examination of IEEE and Science Direct databases. In addition, we will explore various writing and paraphrasing tools in future steps. Moreover, developers within the community should introduce new features or alleviate existing constraints, such as restrictions on page count or the number of PDFs processed per day. Furthermore, it is essential for future studies to evaluate the influence of AI-generated literature reviews on the overall quality and integrity of academic research.

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