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# Doc Assist: Intelligent Document Processing Assistance for Enhanced Accessibility

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## Abstract
*This project presents a desktop assistant designed to retrieve information from non-machine-readable documents, such as scanned images and PDFs. Using Tesseract OCR, the system extracts text, and BM25 is employed for effective document ranking based on user-provided keywords. Additionally, word embeddings are integrated to improve semantic search accuracy. The application is built with Tkinter, offering an intuitive, offline experience. The system's architecture is optimized for quick document retrieval, ensuring minimal resource consumption while maintaining relevance. This documentation covers the design, implementation, and challenges encountered during development.*

***Keywords:*** *OCR, BM25, Semantic Search, Word Embedding's, Document Retrieval.*

## 1. Introduction

In today's digital era, vast amounts of information are stored in documents, ranging from research papers and legal documents to medical records and business contracts. While text-based documents are easily searchable, non-machine-readable formats such as scanned images and PDFs present a significant challenge in information retrieval. Traditional search systems struggle to extract relevant content from such files, leading to inefficiencies in document access. This project aims to solve this issue by developing an intelligent desktop assistant that enables users to efficiently search and retrieve information from scanned and image-based documents. The proposed system incorporates Optical Character Recognition (OCR), document ranking techniques, and semantic search algorithms to improve the accuracy and efficiency of document retrieval. By employing Tesseract OCR, the system converts scanned images and PDFs into machine-readable text, making them searchable. Additionally, the BM25 ranking algorithm enhances keyword-based searches, ensuring that the most relevant documents appear at the top of search results [1]. To further refine retrieval accuracy, word embeddings are incorporated, allowing users to find documents based on contextual meanings rather than exact keyword matches [2]. One of the key aspects of this system is its easy-to-use, offline functionality. Built with Tkinter, the application provides an intuitive graphical interface that enables users to interact seamlessly with the document retrieval process. Unlike cloud-based systems, which require internet connectivity and significant computational resources, this desktop assistant is designed to function efficiently on local hardware with moderate specifications. This ensures accessibility for users working in environments with limited internet access while maintaining high performance and minimal resource consumption [3]. This project has widespread implications across multiple industries, including healthcare, law, research, and business. Organizations and individuals who rely on scanned documents can benefit from an optimized search experience, reducing time spent manually searching for information. By streamlining document retrieval, the assistant enhances productivity and

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enhances workflow efficiency [4]. The integration of AI-based techniques ensures that the system not only retrieves documents accurately but also adapts to user queries in a meaningful way, making it a valuable tool for modern document management [5].

## 2. Data Source and Statement

Traditional document management systems often struggle to process scanned images and non-machine-readable formats, making information retrieval slow and inefficient. These systems primarily depend on manual classification and keyword-based searches, which fail to capture the contextual relevance of the content [6]. As businesses and research institutions generate vast amounts of scanned documents, there is an increasing need for an intelligent solution that enables precise and effective document search. This project addresses that challenge by developing a smart assistant capable of extracting and organizing document data using advanced algorithms and AI-driven techniques. The proposed system makes use of Optical Character Recognition (OCR) technology to convert scanned documents into machine-readable text, making it accessible for searching and analysis. Additionally, it incorporates ranking algorithms such as BM25 to prioritize search results based on relevance, ensuring users find the most useful documents quickly (Figure 1). By incorporating word embeddings, the system enhances search accuracy by understanding the context and relationships between words rather than relying solely on keyword matching. This approach significantly enhances document retrieval efficiency, providing a streamlined solution for users who need to access critical information from various document formats.

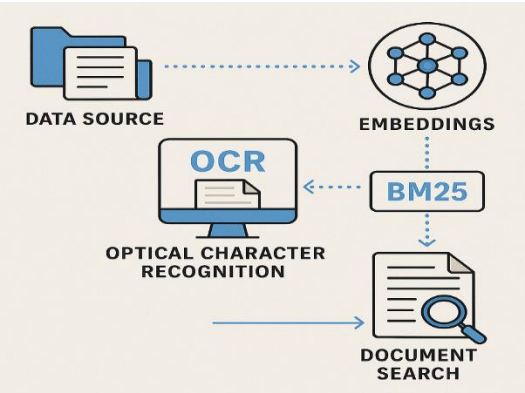


**Figure 1 Doc-Assist**

## 3. Proposed System and Methodology

### 3.1.Data Preprocessing

Effective data preprocessing is essential for improving document retrieval accuracy and efficiency. The system begins by applying noise removal techniques, ensuring that unwanted artifacts such as watermarks, smudges, or background distortions do not interfere with Optical Character Recognition (OCR) processes. Additionally, missing values in extracted text are handled through imputation methods that preserve the document's original meaning while enhancing completeness [7]. Text normalization is a crucial step where inconsistencies in formatting, capitalization, and punctuation are standardized to enable more precise indexing and retrieval of documents. By refining raw data through these methods, the system ensures a smoother and more reliable document-processing pipeline. To optimize computational efficiency, scanned documents are converted into grayscale images, reducing the complexity of image processing [8]. This transformation simplifies pixel intensity variations, allowing for faster and more effective feature extraction. The grayscale conversion process reduces computational overhead while maintaining text clarity, enhancing OCR performance. Furthermore, preprocessing may involve segmentation techniques to isolate key document elements, such as titles, headers, and body text, ensuring structured and meaningful data extraction. These preprocessing steps collectively lay the foundation for a more effective and intelligent document assistant, enabling users to retrieve relevant information with improved accuracy and minimal effort [9].

### 3.2.Intelligent Search and Ranking

To enhance document retrieval efficiency, the system employs “BM25 ranking”, a powerful algorithm that evaluates keyword relevance based on frequency and distribution across documents. Unlike traditional keyword-based search methods, BM25 dynamically scores search queries, prioritizing documents containing highly relevant terms while minimizing less significant matches. This ensures that users quickly access the most

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useful content without manually sifting through large volumes of data. Additionally, BM25 incorporates term saturation principles, preventing frequent words from overshadowing meaningful results, which refines search accuracy. Beyond simple keyword matching, the system incorporates "word embeddings" to understand context and semantic relationships between words. Traditional search engines often fail when users input queries that differ slightly from the original text in a document. By employing word embeddings, the system maps words with similar meanings, allowing users to find relevant content even if their search terms are not exact matches [10]. This technique enhances document discovery, particularly when handling OCR-extracted text, where errors and formatting inconsistencies may otherwise disrupt search accuracy (Figure 2). To further enhance retrieval precision, the system adopts "semantic search methodologies" that analyze the intent behind user queries rather than relying on literal word matches. Semantic search processes meaning at a deeper level by recognizing synonyms, related concepts, and contextual associations. This helps users find documents that align with their specific needs, even when direct keyword matches are unavailable. The integration of "BM25 ranking, word embeddings, and semantic search" establishes a more robust and intelligent document retrieval platform. By combining relevance-based ranking with context-aware search capabilities, the system effectively overcomes the limitations of conventional search engines.

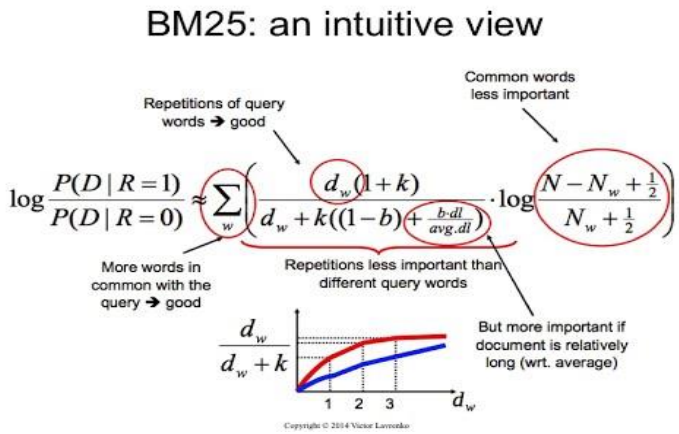


**Figure 2 BM25**

### 3.3.System Architecture and User Interface

The desktop assistant is designed with a easy-to-use interface built using Tkinter, ensuring seamless interaction for document searching and retrieval. The system is developed to handle a variety of document formats, including scanned images and PDFs, converting them into searchable text using Optical Character Recognition (OCR). Users can input queries, browse ranked results, and retrieve relevant documents efficiently without unnecessary complexity. The integrated search mechanisms simplify document retrieval, making it highly beneficial for professionals dealing with large volumes of data. The architecture consists of several essential modules, each playing a specific role in document processing and retrieval. The OCR module extracts text from scanned documents, making non-machine-readable formats accessible for indexing and searching. The data indexing module structures extracted content in an optimized format, ensuring rapid retrieval. The search query execution module processes user queries using ranking techniques like BM25 and semantic search, delivering the most relevant results based on contextual understanding. The seamless interaction between these components ensures users receive precise search results tailored to their specific needs. A key advantage of the assistant is its ability to function offline, eliminating the dependence on cloud-based services that require an internet connection. Unlike web-dependent platforms, the system operates entirely on local hardware, making it accessible in environments where internet connectivity may be unreliable or unavailable. Despite its offline nature, it maintains high performance, processing queries quickly and retrieving results without delays. This approach ensures users can conduct document searches without network constraints, improving accessibility and reliability. The desktop assistant is meticulously engineered to enhance user productivity by offering an intuitive and user-friendly interface. Through its clean layout and logically structured features, users can easily navigate through stored documents without feeling overwhelmed. The integrated search functionality

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enables refined queries, allowing users to locate specific information with precision. Additionally, advanced filtering options and real-time text previews help streamline the review process, eliminating the need to open every file individually. This thoughtful design reduces time spent on document handling, fostering a more efficient workflow. Furthermore, the application stands out for its lightweight architecture, ensuring smooth performance even on systems with modest specifications (Figure 3). It avoids excessive consumption of memory and processing power, making it accessible across a wide range of computing environments. The focus on speed and responsiveness means that users experience minimal delays, which is especially valuable in time-sensitive or professional settings. By combining performance with ease of use, the desktop assistant transforms document management into a hassle-free experience, empowering users to retrieve and utilize critical information with speed and confidence.

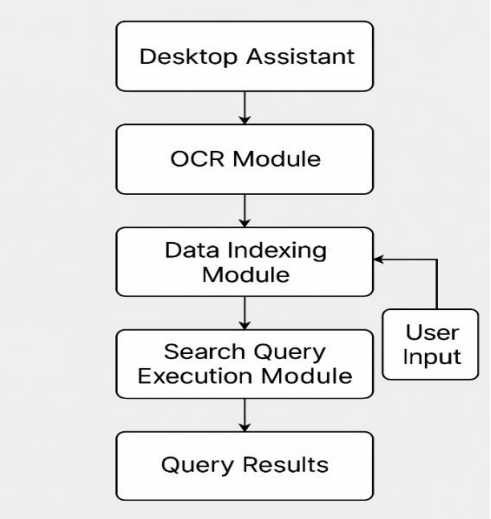


**Figure 3 Flow Chart**

## 4. System Testing and Results

System testing is a vital step in validating the reliability, stability, and accuracy of the intelligent document assistant. To ensure robust performance, the system underwent multiple testing methodologies, including unit testing, integration testing, functional testing, and system testing. Unit testing focused on individual components such as Optical Character Recognition (OCR), indexing, and search query processing, guaranteeing their correct operation. Integration testing verified the seamless interaction between these modules, ensuring smooth data transfer and effective workflow. Functional testing checked whether the system met predefined operational requirements, confirming that users could efficiently perform document searches and retrievals. Finally, system testing analyzed the overall performance, ensuring the assistant remained responsive under different workload conditions. The testing phase delivered highly satisfactory results, demonstrating that the system met all intended specifications. Each test case—search accuracy, ranking efficiency, retrieval speed, and interface responsiveness—was executed without identifying defects. The document assistant performed exceptionally well in processing scanned documents, accurately converting them into searchable text, and retrieving relevant results with minimal latency. These findings indicate a well-optimized system capable of handling complex search queries without performance degradation. Scalability testing further reinforced the robustness of the platform, showing that it could efficiently process multiple concurrent queries while maintaining consistent response times. The assistant demonstrated the capability to handle large document repositories without compromising search precision. Users were able to access relevant documents regardless of increasing data loads, proving its adaptability in varied environments. Additionally, stress testing validated that the system remained stable even when subjected to extensive operations, ensuring its reliability over prolonged usage. The comprehensive evaluation confirmed that the document assistant is ready for deployment in real-world applications. With high accuracy in text extraction, advanced ranking mechanisms, and effective retrieval capabilities, the platform delivers a streamlined document management experience. The success of system testing assures users of its reliability, paving the way for effective document searching and retrieval without dependence on manual searching methods. The results establish this assistant as a powerful tool for professionals and

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researchers dealing with extensive document archives.

## Conclusion and Future Enhancement

The intelligent document assistant presented in this project effectively addresses the challenges associated with retrieving information from scanned documents and non-machine-readable formats. By integrating Optical Character Recognition (OCR) with ranking algorithms like BM25 and semantic search techniques, the system significantly enhances the accuracy and efficiency of document retrieval. Users can perform searches based on contextual meaning rather than exact keywords, making information access more intuitive and reliable. The results of system testing confirmed the platform's reliability, stability, and effectiveness in document retrieval tasks. The assistant demonstrated high accuracy in extracting text, ranking search results, and responding to user queries with minimal latency. Scalability tests indicated that the system can manage large document repositories and multiple concurrent queries without compromising performance. With its ability to streamline document management, the assistant provides an essential solution for professionals, researchers, and businesses dealing with extensive archives. Looking ahead, several future enhancements can further refine the system's capabilities. Improvements in OCR processing could increase recognition accuracy for handwritten and low-quality scanned documents, broadening the system's applicability. Integrating additional machine learning techniques, such as deep learning-based NLP models, could enhance semantic search precision and document ranking. Expanding support for multilingual document retrieval would make the assistant more versatile, catering to users handling diverse language content. Further enhancements could also involve optimizing system efficiency, reducing processing time for large-scale document queries, and improving user interface features. Implementing a more advanced graphical representation of search results, including document previews, could enhance the user experience. Additionally, enabling cloud-based storage options while maintaining offline functionality would offer users greater flexibility in managing their document repositories. the document assistant could continue to evolve into a powerful, adaptable tool for modern information retrieval.

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