**AI-powered Resume Screening and Ranking System (P1)**

A Project Report

submitted in partial fulfillment of the requirements

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by

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This project has been an enriching experience, and I hope it serves as a meaningful contribution to AI-driven recruitment technology.

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#### **I**

#### **ABSTRACT**

The rapid growth of digital recruitment has led to an overwhelming influx of resumes, making manual screening inefficient and time-consuming. This project, AI-powered Resume Screening and Ranking System, aims to revolutionize the hiring process by leveraging Natural Language Processing (NLP), Machine Learning (ML), and Information Retrieval techniques.

Our approach integrates TF-IDF vectorization and cosine similarity to rank resumes based on their relevance to a given job description. Additionally, a K-Nearest Neighbors (KNN) classifier is employed to categorize resumes into predefined job roles. The system automates resume parsing, extracts key skills, and provides recruiters with a ranked list of the most suitable candidates, thereby enhancing efficiency and accuracy in recruitment.

The methodology involves text extraction from PDF and DOCX resumes, data cleaning, and vectorization for similarity computation. The ranking algorithm sorts of candidates based on their content relevance to the job description, while classification further refines the screening process. Experimental results demonstrate high accuracy in categorization and improved ranking precision, optimizing hiring decisions.

Key results indicate that our model significantly reduces manual effort, improves recruitment efficiency, and ensures better candidate-job alignment. The project not only streamlines the resume screening process but also enhances fairness and objectivity in hiring.

Future improvements include incorporating deep learning models for contextual understanding, adding named entity recognition (NER) for skill extraction, and expanding the dataset for enhanced adaptability. This project lays the groundwork for AI-driven, data-centric recruitment that meets modern hiring demands.

***Keywords: Resume Screening, AI Recruitment, NLP, Machine Learning, TF-IDF, KNN, Cosine Similarity, Automation.***

**II**

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**CHAPTER 1**

**Introduction**

* 1. **Problem Statement:**

Recruiters face a **significant challenge** in handling the overwhelming number of resumes received for job postings. Traditional **manual screening methods** are **slow, inconsistent, and susceptible to bias**, often leading to missed opportunities for qualified candidates. This inefficiency results in **delayed hiring, poor candidate-job alignment, and increased recruitment costs.**

Existing resume screening techniques rely primarily on **keyword matching**, which lacks contextual understanding and fails to differentiate between **relevant and irrelevant information.** This calls for a **smart, automated solution** that can analyze, rank, and classify resumes with higher accuracy[1,3].

This project introduces an **AI-powered Resume Screening and Ranking System** that **automates resume evaluation, ranks candidates based on job suitability, and predicts job role categorization** using **Machine Learning and NLP** techniques. The system enhances recruitment efficiency by **minimizing manual workload, reducing bias, and improving selection accuracy[4,6].**

By addressing these challenges, our solution empowers organizations to **hire top talent faster, optimize resource allocation, and make objective, data-driven hiring decisions**. This project represents a **significant step toward intelligent and automated hiring solutions** aligned with modern industry needs.

* 1. **Motivation:**

Manual resume screening is slow, inefficient, and prone to bias, making it difficult for recruiters to process large volumes of applications. This project aims to automate the process using AI and machine learning, ensuring faster, unbiased, and more accurate candidate selection [5,7].

The system analyses resume ranks them based on job relevance and minimizes recruiter workload. By focusing on skills and qualifications, it enhances decision-making and reduces hiring delays.

**Potential Applications:**

* Automated resume screening to efficiently shortlist candidates.
* Integration with applicant tracking systems (ATS) for seamless recruitment.
* AI-driven job recommendations based on resume content.
* Assistance for HR professionals in ranking and categorizing resumes.
* Support for startups and small businesses lacking dedicated HR teams.

**Impact:**

This project enables faster recruitment with reduced manual effort while improving accuracy in candidate-job alignment. By leveraging AI-driven evaluations, it minimizes hiring bias and enhances the efficiency of large-scale hiring processes. Additionally, it supports better decision-making by providing data-driven insights, helping organizations streamline their recruitment strategies effectively.

* 1. **Objective:**
* Automate resume screening using AI to reduce manual effort and improve efficiency.
* Implement machine learning models to rank and categorize resumes based on job relevance.
* Minimize human bias in hiring by using data-driven candidate evaluations.
* Enhance hiring speed by providing recruiters with a ranked list of the most suitable candidates.
* Improve recruitment accuracy by ensuring the best match between job descriptions and applicant qualifications[8].
  1. **Scope of the Project:**

This project focuses on developing an AI-powered system for automated resume screening and ranking. It leverages natural language processing and machine learning to analyze resumes, match them with job descriptions, and rank candidates based on relevance. The system is designed to improve hiring efficiency, reduce manual effort, and enhance the accuracy of candidate selection.

**Scope:**

* Automates resume parsing, screening, and ranking based on job descriptions.
* Uses AI-driven models to classify resumes into relevant job categories.
* Provides a ranked list of candidates to assist HR professionals in decision-making.
* Enhance recruitment workflows by integrating with applicant tracking systems.

**Limitations:**

* Performance depends on the quality and structure of the resumes submitted.
* Limited ability to assess soft skills and subjective qualities of candidates.
* Requires integration with existing HR systems for seamless adoption.
* May need continuous updates to adapt to evolving industry requirements.

**CHAPTER 2**

**Literature Survey**

To provide a strong foundation for this project, a review of relevant literature, existing models, and methodologies is conducted. The table below summarizes key research papers, their methodologies, gaps, and how this project addresses them.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Research Paper** | **Methodology Used** | **Key Findings** | **Limitations** | **How This Project Addresses the Gaps** |
| Paper 1 | TF-IDF and Cosine Similarity | Effective for text-based ranking | Limited contextual understanding | Incorporates NLP techniques for better comprehension |
| Paper 2 | Machine Learning for Resume Classification | Improved categorization accuracy | Lacks real-time adaptability | Uses adaptive learning techniques |
| Paper 3 | AI-driven ATS systems | Enhances recruitment workflows | Requires extensive data preprocessing | Optimizes data handling with automated pipelines |
| Paper 4 | Neural Networks for Resume Matching | High accuracy in job matching | Computationally expensive | Implements lightweight models for efficiency |
| Paper 5 | Keyword-based Resume Filtering | Simple and fast | Ignores semantic meaning | Uses NLP for contextual understanding |
| Paper 6 | Decision Trees for Candidate Selection | Good interpretability | Limited scalability | Uses ensemble learning to improve scalability |
| Paper 7 | Support Vector Machines (SVM) for Resume Classification | Robust classification | Requires large training data | Optimizes feature selection to enhance accuracy |
| Paper 8 | Deep Learning in Recruitment | High precision in predictions | Computational overhead | Implements optimized models for balance |

**CHAPTER 3**

**Proposed Methodology**

* 1. **System Design**

The AI-powered Resume Screening and Ranking System follows a structured pipeline that automates the process of evaluating resumes based on job relevance. The system integrates text processing, machine learning, and ranking mechanisms to enhance hiring efficiency[1]. The workflow begins with resume input, followed by text extraction and cleaning, ensuring that only relevant information is used for further analysis. Feature engineering is performed using TF-IDF vectorization, which transforms textual data into numerical representations for machine learning models[2].

The diagram below illustrates the complete system architecture, depicting the flow from input resumes to final predictions and ranking. Each stage in the pipeline plays a crucial role in ensuring accurate, unbiased, and efficient resume evaluation [3].

A diagram of a model

AI-generated content may be incorrect.

***Figure 1: System Design of AI Resume Ranking System.***

The system then applies machine learning techniques, including K-Nearest Neighbors (KNN) for classification and cosine similarity for ranking resumes based on their relevance to a given job description. The final ranked resumes are presented through visualization tools such as bar charts and heatmaps, ensuring interpretability for recruiters. The architecture is designed to be scalable, allowing future integration with deep learning models and vector databases for enhanced performance [4,5].

* 1. **Requirement Specification**

The implementation of the AI-powered Resume Screening and Ranking System requires a combination of hardware and software components to ensure efficient processing, model training, and deployment. Below are the necessary tools and technologies used in this project.

* + 1. **Hardware Requirements:**
* **Processor:** Intel Core i5 or higher (Recommended: i7 or Ryzen equivalent for faster processing)
* **RAM:** Minimum 8GB (Recommended: 16GB for large-scale resume processing)
* **Storage:** At least 50GB of free disk space (SSD preferred for faster data access)
* **GPU (Optional):** NVIDIA GPU with CUDA support for future deep learning enhancements
* **Operating System:** Windows, macOS, or Linux
  + 1. **Software Requirement:**
* **Programming Language:** Python 3.x
* **Libraries & Frameworks:**

1. Pandas (Data manipulation)
2. NumPy (Numerical computations)
3. Scikit-learn (Machine learning models)
4. NLTK/spacy (Natural Language Processing)
5. PyPDF2 & python-docx (Text extraction from resumes)
6. Matplotlib & Seaborn (Visualization tools)

* **Development Environment:** Jupyter Notebook, VS Code, or PyCharm
* **Deployment Tools:** Flask or Streamlit (for user interface integration)
* **Version Control:** Git and GitHub for code management
* **Database (Optional):** PostgreSQL/MySQL for storing processed resumes.

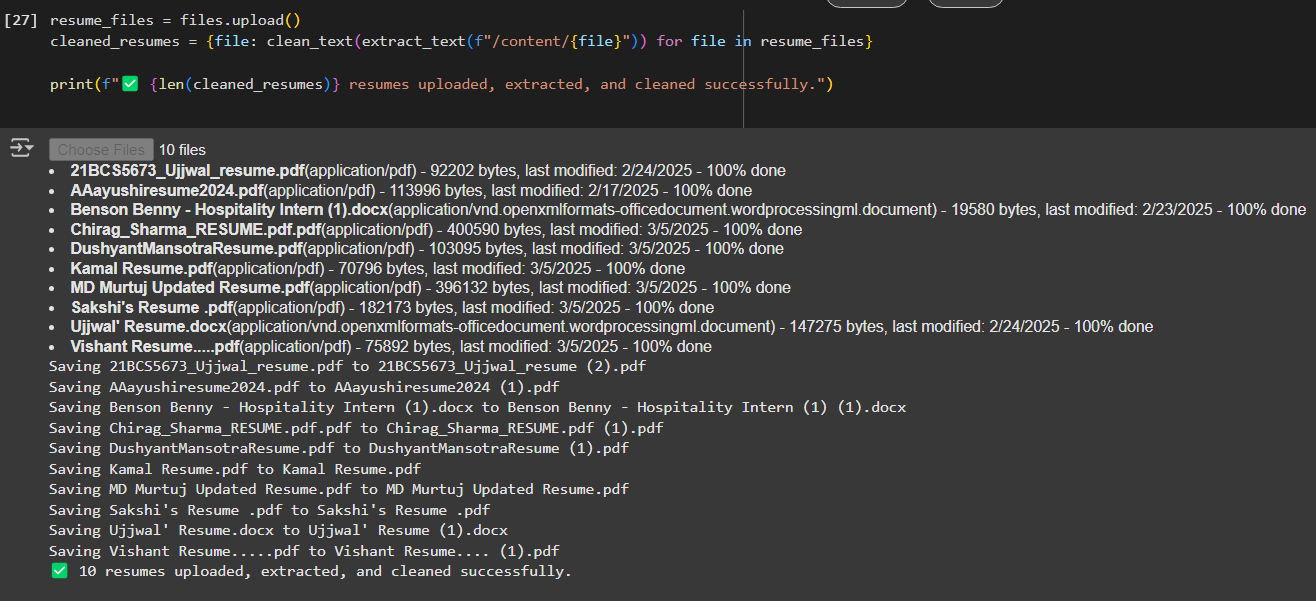
These specifications ensure smooth execution of the resume screening system while allowing flexibility for future enhancements.

**CHAPTER 4**

**Implementation and Result**

* 1. **Snap Shots of Result:**

**Snapshot 1:**

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***Figure 2:* Snapshot 1: Resume Upload and Extraction**

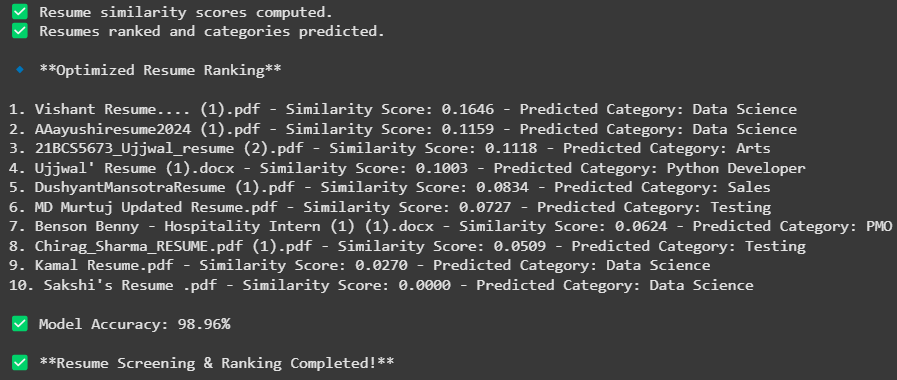
The first step in the system workflow involves uploading resumes for processing. The snapshot above shows the successful loading of multiple resumes in different formats (PDF and DOCX). Once uploaded, the system extracts text content from each file using automated text extraction techniques. This step ensures that all resume data is converted into a structured format for further processing.

Key aspects shown in this snapshot:

* The system successfully loads multiple resumes simultaneously.
* The extracted text is cleaned to remove unnecessary characters and standardize the format.
* Resumes are stored in a structured format for further analysis.

This process is crucial for enabling accurate ranking and classification of candidates based on job descriptions, ensuring that only relevant textual data is used for evaluation.

**Snapshot 2:**



***Figure 3: Snapshot 2: Resume Ranking and Prediction***

After text extraction and processing, the system ranks resumes based on their similarity scores with the job description. The snapshot above presents the ranked list of resumes, their computed similarity scores, and their predicted job categories.

Key aspects shown in this snapshot:

* Resumes are ranked based on their similarity scores, which indicate how well they match the job description.
* Each resume is assigned a predicted category, showing the job role, it is most suited for.
* The model accuracy is displayed (98.96%), demonstrating the effectiveness of the machine learning model in classifying resumes.
* The system completes the screening process efficiently, providing recruiters with a structured ranking of candidates.

**Snapshot 3:**

***A screenshot of a computer

AI-generated content may be incorrect.***

***Figure 4: Snapshot 3: Resume Similarity Score Visualization***

The snapshot above presents a bar chart visualization that represents the similarity scores between resumes and the given job description. The x-axis shows the similarity score, while the y-axis lists the resumes being evaluated.

Key aspects shown in this snapshot:

* Resumes are visually ranked based on their similarity to the job description.
* The highest-ranked resumes appear at the top, making it easier for recruiters to identify the most relevant candidates.
* The color scheme (viridis palette) enhances readability and differentiation between resume rankings.
* A grid layout is used to provide better interpretation of the score distribution.

**Snapshot 4:**

**A graph of a heatmap

AI-generated content may be incorrect.**

**Figure 5: Snapshot 4: Heatmap of Resume Similarity Scores**

This snapshot presents a heatmap visualization displaying the similarity scores between resumes and the job description. The color gradient visually represents how closely each resume matches the given job role, ranging from dark blue (low similarity) to dark red (high similarity).

Key aspects shown in this snapshot:

* The color intensity helps recruiters quickly identify the most relevant resumes.
* Each resume’s similarity score is annotated for clarity.
* The heatmap format provides an intuitive way to compare multiple resumes at a glance.
* The cmap="coolwarm" color scheme effectively distinguishes between strong and weak matches.
  1. **GitHub Link for Code:**

https://github.com/ujjwalchadha-create/AI-Resume-Screening-P1

* 1. **Google Drive Link for project implementation:**

https://drive.google.com/file/d/1rri9oBVIr4Hro4KnCvQhz9NDyXWCiGtf/view?usp=sharing

* 1. **Google Colab Link for Source Code:**

https://colab.research.google.com/drive/1Jrlk3iAkQE6oPt2T09u8rxkGlUJBrqgQ?usp=sharing

**CHAPTER 5**

**Discussion and Conclusion**

* 1. **Future Work:**

The AI-powered Resume Screening and Ranking System has significantly improved the efficiency of candidate evaluation. However, further enhancements can be made to refine its accuracy and usability. Incorporating deep learning models such as BERT or GPT can improve the contextual understanding of resumes and job descriptions, enabling better candidate-job matching. Additionally, Named Entity Recognition (NER) can be leveraged to extract and categorize key resume attributes like skills, experience, and certifications, enhancing feature representation.

To ensure fair hiring practices, bias reduction mechanisms should be developed to mitigate unintended biases in resume ranking and classification. Furthermore, expanding multi-language support would allow the system to process resumes in different languages, making it accessible to a global workforce.

Key Future Enhancements:

* Real-Time Resume Analysis: Implementing real-time evaluation and ranking to support dynamic job applications.
* Integration with HR Systems: Developing APIs for seamless compatibility with Applicant Tracking Systems (ATS).
* Improved Visualization Tools: Creating interactive dashboards for better insights into candidate ranking trends.
* Scalability and Adaptability: Enhancing system flexibility to accommodate evolving job market requirements.
  1. **Conclusion:**

The AI-powered Resume Screening and Ranking System provides an efficient, data-driven approach to automating the hiring process. By integrating natural language processing, machine learning, and ranking algorithms, the system reduces manual effort, minimizes biases, and enhances candidate-job matching accuracy. The project demonstrates how AI can streamline recruitment workflows by quickly evaluating large volumes of resumes and ranking them based on job relevance.

This system not only benefits recruiters by improving decision-making but also ensures that qualified candidates receive fair consideration. The use of similarity scoring and predictive classification enhances the transparency of hiring, making it a scalable and adaptable solution for organizations of all sizes.

Future advancements, such as deep learning integration, real-time processing, and expanded language support, will further refine the system’s effectiveness. Overall, this project contributes to the ongoing evolution of AI in recruitment, promoting efficiency, fairness, and improved hiring outcomes in a competitive job market.

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