

Intelligent ATS Resume Optimization and Career Intelligence System

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Abstract: The rapid growth of online recruitment has increased the need for efficient resume screening and candidate evaluation. Traditional Applicant Tracking Systems (ATS) mainly rely on keyword matching, which may overlook qualified candidates whose resumes are not ATS-friendly. This paper presents an Intelligent ATS Resume Optimization and Career Intelligence System developed using Python, Flask, MySQL, Natural Language Processing (NLP), and Machine Learning (ML). The proposed system analyzes resumes by comparing them with job descriptions, calculates ATS scores, identifies missing skills, and provides personalized recommendations to improve resume quality. It also predicts suitable career roles, generates interview questions, and produces downloadable ATS reports. An administrator module is included for managing users, resumes, job descriptions, and analytical reports. The proposed system offers an integrated platform that enhances recruitment efficiency while helping job seekers improve their employability and career readiness.

Keywords: Applicant Tracking System, Resume Optimization, Natural Language Processing, Machine Learning, Career Prediction, Resume Analysis.

1. INTRODUCTION

The rapid growth of online recruitment has transformed the hiring process, enabling organizations to receive a large number of job applications through digital platforms. Reviewing every resume manually is time-consuming and often leads to inconsistencies in candidate selection. To overcome this challenge, many companies use Applicant Tracking Systems (ATS) to automate resume screening. However, conventional ATS tools primarily rely on keyword matching and resume formatting, which may result in the rejection of qualified candidates whose resumes are not properly optimized. This paper presents an Intelligent ATS Resume Optimization and Career Intelligence System, developed using Python, Flask, MySQL, Natural Language Processing (NLP), and Machine Learning (ML). The proposed system analyses uploaded resumes by comparing them with job descriptions, calculates an ATS compatibility score, identifies missing skills and keywords, and provides personalized recommendations to improve resume quality. It also predicts suitable career paths, generates interview questions, and produces downloadable ATS reports, helping candidates enhance their employability. The system includes an administrator module for managing users, resumes, job descriptions, and analytical reports. By integrating resume analysis, career guidance, and interview preparation into a single platform, the proposed system provides an effective solution for both job seekers and recruiters. Overall, the system aims to simplify the recruitment process while assisting candidates in building ATS-friendly resumes and improving their career opportunities.

A. Contribution

The main contributions of this work include:

- Development of an AI-based web application for intelligent ATS resume analysis and career guidance.
- Automatic resume evaluation by comparing uploaded resumes with job descriptions using NLP techniques.
- Calculation of ATS compatibility scores and identification of missing technical skills and important keywords.



- Personalized recommendations to improve resume quality and increase ATS compatibility.
- Career role prediction and interview question generation based on the candidate's skills and resume content.
- Implementation of the system using Python, Flask, HTML5, CSS3, Bootstrap, JavaScript, MySQL, NLP, and

Machine Learning

- Development of an administrator dashboard for managing users, resumes, job descriptions, and generated reports
- Generation of downloadable ATS analysis reports for easy review and future reference.

Overall, the proposed system provides an efficient and user-friendly solution that helps job seekers create ATS-optimized resumes while supporting recruiters in the resume screening process.

II. RELATED WORK AND RESEARCH GAP

The use of Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) has brought significant improvements to modern recruitment systems. As organizations receive a large number of job applications for every vacancy, manual resume screening has become a time-consuming and challenging task. To simplify this process, several researchers have developed Applicant Tracking Systems (ATS) that automatically analyze resumes and compare them with job descriptions. These systems help recruiters identify suitable candidates more efficiently while reducing the effort involved in manual evaluation. Many existing studies have focused on improving resume screening through keyword-based matching techniques. Traditional ATS applications evaluate resumes by checking whether important keywords mentioned in the job description are present in the candidate's resume. Although this approach speeds up the recruitment process, it often fails to recognize candidates who possess the required skills but describe them using different words or formats. To overcome this limitation, researchers have introduced NLP techniques such as TF-IDF and Cosine Similarity, which improve resume matching by understanding the similarity between resume content and job descriptions instead of relying only on exact keyword matches. Recent research has also explored the use of Machine Learning for career recommendation and candidate evaluation. These systems analyze a candidate's educational background, technical skills, and work experience to suggest suitable job roles. Some applications provide resume feedback, while others generate interview questions or recommend learning resources. Although these approaches improve different stages of the recruitment process, they are generally designed to perform only a specific task rather than providing a complete career support system. Despite these developments, most existing ATS applications still have several limitations. Many systems stop after generating an ATS score without clearly explaining why the score is low or how the candidate can improve it. Features such as skill gap analysis, personalized resume recommendations, career prediction, interview preparation, and downloadable reports are often missing or available only through separate applications. This makes the job preparation process less effective and requires users to depend on multiple platforms.

Research Gap:

From the literature survey, it is evident that current ATS and recruitment systems mainly concentrate on resume screening and candidate ranking. While these systems help automate recruitment, they provide limited support for improving resume quality and preparing candidates for future career opportunities. Most of the available applications focus on a single feature, such as ATS scoring, resume matching, or career recommendation, without integrating all these functionalities into one platform. To address these limitations, the proposed Intelligent ATS Resume Optimization and Career Intelligence System combines resume analysis, ATS score calculation, skill gap identification, personalized resume improvement suggestions, career prediction, interview question generation, and downloadable ATS reports within a single web-based application. In addition, the system includes an administrator dashboard for managing users, resumes, job descriptions, and analysis reports. By bringing these features together, the proposed



system provides a more comprehensive, practical, and user-friendly solution that supports both recruiters in candidate evaluation and job seekers in improving their employability.

III. METHODOLOGY

The proposed Intelligent ATS Resume Optimization and Career Intelligence System is designed to assist job seekers in improving their resumes and preparing for recruitment through intelligent resume analysis. The system combines Natural Language Processing (NLP) and Machine Learning (ML) techniques to compare resumes with job descriptions and provide meaningful recommendations. The complete workflow consists of resume parsing, text preprocessing, feature extraction, ATS score calculation, skill gap analysis, career prediction, interview question generation, and report creation. Each stage is carefully implemented to improve the accuracy of resume evaluation while providing useful guidance to the user.

3.1 Data Collection

The system uses two primary sources of data: resumes uploaded by users and job descriptions added by the administrator. Resumes are accepted in PDF format and are processed to extract relevant information such as personal details, educational qualifications, technical skills, certifications, and work experience. Job descriptions contain the skills and qualifications required for specific job roles and are stored in the database for comparison.

3.2 Data Preprocessing

The extracted resume text is preprocessed before analysis to improve the quality of the input data. During this stage, unnecessary symbols, special characters, punctuation, and extra spaces are removed. The text is converted into a standard format, and common stop words are eliminated. Tokenization and normalization are also performed to ensure that the extracted information is clean, consistent, and suitable for further processing.

3.3 Feature Extraction

After preprocessing, the system extracts important features from both the resume and the job description. These features mainly include technical skills, programming languages, educational qualifications, certifications, and relevant keywords. NLP techniques are used to identify these features accurately, which helps in understanding the similarity between the candidate's profile and the job requirements.

3.4 Resume Matching and ATS Score Calculation

The processed resume is compared with the selected job description using TF-IDF Vectorization and Cosine Similarity. Based on the similarity score and the presence of required skills, the system calculates an ATS compatibility score. It also identifies missing keywords and skill gaps that may reduce the chances of the resume being shortlisted. Personalized suggestions are then provided to help users improve their resumes according to industry requirements.

3.5 Career Prediction and Interview Question Generation

Based on the extracted skills and resume content, the system predicts suitable career roles for the candidate. It also generates interview questions related to the identified technical skills, enabling users to prepare more effectively for recruitment. These additional features provide career guidance beyond traditional ATS evaluation.

3.6 Report Generation and Administration

After completing the analysis, the system generates a detailed ATS report containing the ATS score, identified skills, missing keywords, improvement suggestions, career predictions, and interview questions. The report can be downloaded in PDF format for future reference. An administrator dashboard is also provided to manage users, uploaded resumes, job descriptions, and generated reports, ensuring smooth system administration.



IV. DATASET DESCRIPTION

The proposed system uses candidate resumes and job descriptions as the primary sources of data for resume analysis. Candidate resumes contain information such as personal details, educational qualifications, technical skills, projects, certifications, and work experience. The job descriptions include the required skills, qualifications, responsibilities, and keywords for different job roles. These datasets are used to evaluate resume compatibility and generate ATS analysis. Before the analysis, the extracted text from resumes and job descriptions is preprocessed by removing unnecessary symbols, punctuation marks, stop words, and extra spaces. The cleaned text is then converted into a standard format to improve the accuracy of feature extraction and resume matching. The processed data is further used to identify technical skills, calculate ATS scores, detect missing keywords, and provide personalized recommendations. The dataset also supports career prediction, interview question generation, and ATS report creation. Since the administrator can upload new job descriptions at any time, the system can analyze resumes for different job roles without modifying the application.

A. Dataset Distribution

The dataset consists of resumes from candidates with different educational backgrounds, technical skills, certifications, projects, and experience levels. It also contains job descriptions for multiple software-related roles. This variety allows the system to evaluate resumes against different job requirements and generate accurate ATS scores and recommendations. Each uploaded resume is compared with the selected job description to determine the matching skills, missing keywords, and overall compatibility. The distribution of resumes and job descriptions used during system evaluation is shown in figure:

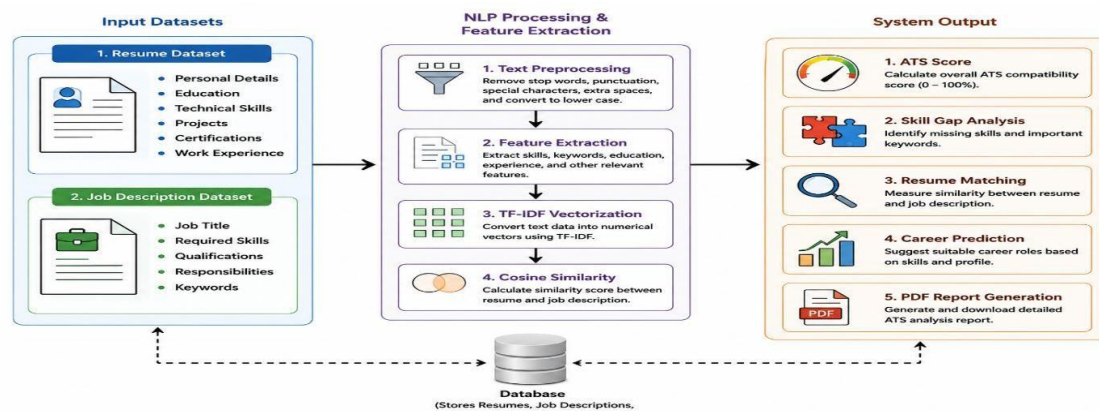


Figure 1: Distribution of Resume and Job Description Dataset

Figure 1: Dataset Distribution of Resume and Job Description Records

B. Statistical Analysis

A statistical analysis was carried out to understand the characteristics of the collected resume and job description data. The analysis focused on identifying the frequency of technical skills, educational qualifications, certifications, projects, and work experience available in the uploaded resumes. Similarly, the required skills and keywords from different job descriptions were analyzed to understand common recruitment requirements. The statistical analysis also helped identify missing values, duplicate information, and inconsistencies in the extracted text before performing ATS analysis. This preprocessing stage improved the quality of the dataset and contributed to more accurate resume matching and ATS score calculation. A summary of the extracted resume attributes and job description features is presented in figure.



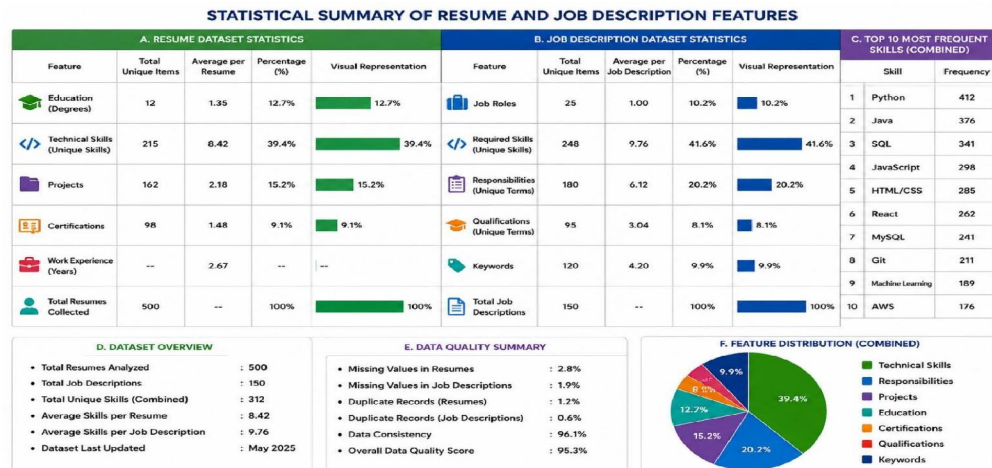


Figure 2: Statistical Summary of Resume and Job Description Dataset

Figure 2: Statistical Summary of Resume and Job Description Features

V. IMPLEMENTATION

The proposed Intelligent ATS Resume Optimization and Career Intelligence System was developed to simplify the resume evaluation process and provide meaningful career guidance to job seekers. The application is built using Python and the Flask framework, while MySQL is used to manage user information, uploaded resumes, job descriptions, and generated reports. The system combines Natural Language Processing (NLP) techniques with machine learning-based text analysis to evaluate resumes more effectively and provide personalized recommendations.

A. Resume Processing and ATS Analysis

The implementation begins when a user uploads a resume in PDF format through the web application. The system extracts the resume content and processes the text to remove unnecessary symbols, extra spaces, and commonly used words that do not contribute to the analysis. This preprocessing step helps improve the quality of the extracted information and ensures consistent results. After cleaning the data, important details such as technical skills, educational qualifications, certifications, projects, and work experience are identified. The processed resume is then compared with the selected job description using TF-IDF Vectorization and Cosine Similarity techniques. Based on the similarity between the resume and the job description, the system calculates an ATS score, identifies missing skills and keywords, and provides suggestions that help candidates improve their resumes.

B. Web Application

The web application was developed using HTML5, CSS3, Bootstrap, JavaScript, Python, Flask, and MySQL to provide a simple and interactive user experience. Users can register, log in securely, upload resumes, view ATS analysis results, and download detailed reports through an easy-to-use interface. The Flask framework manages all backend operations, including resume processing, user authentication, database communication, and report generation, ensuring that the application performs efficiently and reliably.

C. Career Prediction and Interview Question Generation

In addition to resume analysis, the system provides career guidance by predicting suitable job roles based on the candidate's technical skills and qualifications. It also generates interview questions related to the identified skills, allowing users to prepare for technical interviews more effectively. Once the analysis is completed, the application



generates a detailed ATS report containing the ATS score, matching skills, missing keywords, career recommendations, and interview questions, which can be downloaded in PDF format for future reference.

D. Additional Features and Workflow

The application includes several additional features that improve both usability and system management. Users can verify their accounts using email OTP verification, reset forgotten passwords, manage their profiles, and access previously generated ATS reports. An administrator dashboard is also provided to manage users, upload job descriptions, monitor resume analysis, and review generated reports. The overall workflow starts with user registration and login, followed by resume upload, text extraction, preprocessing, feature extraction, ATS score calculation, skill gap analysis, career prediction, interview question generation, and report creation. Each stage of the implementation was carefully tested to ensure accurate analysis, reliable performance, and a smooth user experience. By integrating all these functionalities into a single platform, the proposed system offers a practical solution that assists both recruiters and job seekers throughout the recruitment process.

E. Database Management and Report Generation

The system uses MySQL to securely store user information, uploaded resumes, job descriptions, ATS scores, and analysis reports. The database ensures efficient data management and allows users to access their previous resume analyses whenever required. After the analysis is completed, the system automatically generates a detailed PDF report containing the ATS score, identified skill gaps, matching skills, and personalized improvement suggestions. This feature enables users to easily download, review, and track their resume performance while ensuring reliable and organized data management.

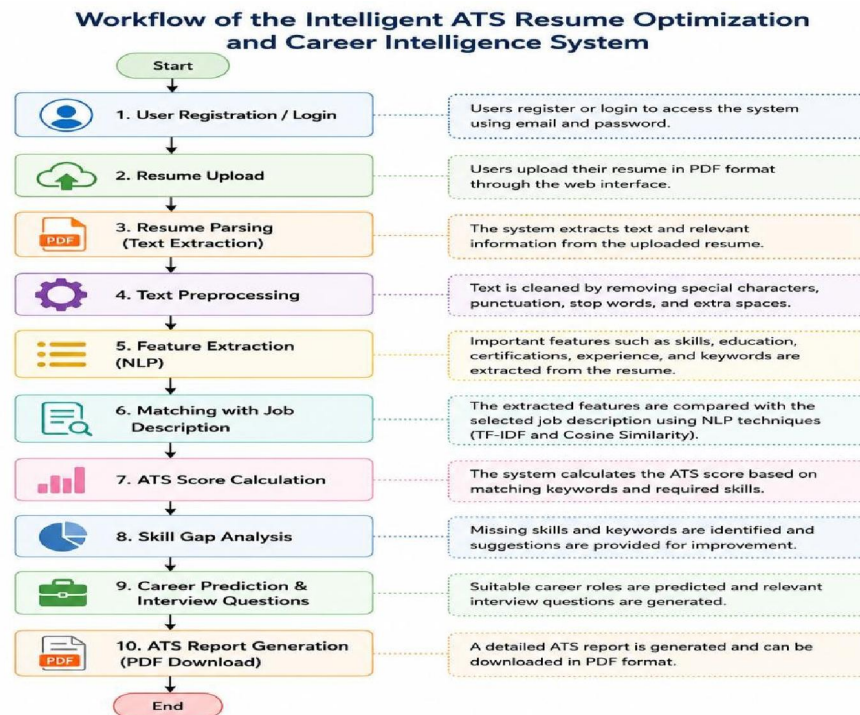


Figure 3: Workflow of the Intelligent ATS Resume Optimization and Career Intelligence System

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VI. FUTURE WORK

The proposed Intelligent ATS Resume Optimization and Career Intelligence System provides an efficient platform for resume evaluation and career guidance. Although the current system performs well, there are several opportunities for further improvement. Future enhancements can focus on making the application more intelligent, accurate, and user-friendly by incorporating advanced Artificial Intelligence and Machine Learning techniques. One possible improvement is the integration of the system with online job portals so that users can receive real-time job recommendations based on their skills and ATS score. The system can also be enhanced by providing AI-based resume rewriting suggestions that help users improve their resume content, formatting, and keyword usage according to industry standards. In addition, personalized learning recommendations can be included to suggest relevant courses and certifications that help candidates bridge their identified skill gaps.

Future versions of the application may also support multiple languages, allowing users to upload and analyze resumes in different languages. Features such as AI-powered mock interviews, voice-based assistance, mobile application support, and cloud-based data storage can further improve the overall user experience. These enhancements will make the system more flexible and capable of meeting the changing requirements of modern recruitment and career development.

Overall, the proposed system has significant potential for future growth and can be developed into a comprehensive career guidance platform that supports users throughout their professional journey.

VII. CONCLUSION

The Intelligent ATS Resume Optimization and Career Intelligence System was developed to simplify the resume screening process and provide meaningful career guidance to job seekers. The system combines Natural Language Processing (NLP) and Machine Learning (ML) techniques to analyze resumes, compare them with job descriptions, calculate ATS scores, identify missing skills, and provide personalized suggestions for resume improvement. This enables candidates to understand how well their resumes match specific job requirements and identify areas that need improvement. In addition to resume analysis, the system offers career prediction, interview question generation, and downloadable ATS reports, making it a complete platform for career preparation. The administrator module allows efficient management of users, resumes, job descriptions, and generated reports, ensuring smooth operation of the application. The user-friendly interface further improves accessibility and makes the system easy to use for both job seekers and administrators.

The application was successfully implemented using Python, Flask, MySQL, HTML, CSS, Bootstrap, JavaScript, and NLP techniques. The results demonstrate that the proposed system effectively supports resume optimization while reducing the time and effort involved in manual resume evaluation. By integrating multiple career-related features into a single platform, the application provides a practical solution for improving both recruitment efficiency and candidate preparedness. In conclusion, the proposed system serves as a valuable tool for enhancing resume quality and supporting career development. With future enhancements and the adoption of more advanced AI technologies, it has the potential to become a comprehensive and intelligent career assistance platform that benefits both job seekers and recruiters.

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