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# Resume Visualization and Analysis

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**Abstract: Finding the right candidate in today's competitive job market is not easy. Manually going through resumes takes a lot of time and can easily lead to mistakes. This project introduces a smarter way to handle resumes by using technologies like Natural Language Processing (NLP), Machine Learning (ML), to streamline and enhance candidate selection.**

**We built a system that reads resumes automatically, analyzes skills and experience, and shows important information visually. Using dashboards, recruiters can easily filter, compare, and select candidates. Our tests showed that recruiters became 40% faster and more accurate at shortlisting candidates. This project offers a scalable and modern solution to improve the recruitment process.**

***Key Words*: Resume Analysis, Visualization, Recruitment Process, Data Analysis, Machine Learning.**

## INTRODUCTION

In the modern-day competitive job market, making the right recruitment is both imperative and difficult. Recruiters typically get hundreds, or even thousands, of resumes for one advertisement. It is not only time-consuming but also susceptible to human error, unconscious prejudice, and fatigue to manually screen every resume. Therefore, shortlisting candidates can be inefficient and non-uniform, resulting in lost opportunities to both employers and deserving candidates.

Conventional resume screening processes are dependent greatly on human judgment and perception, which are time-constrained and limited in cognitive capacity. Reading and analyzing each resume individually turns into a man-hours-consuming operation that slows down the recruitment process and raises recruitment expenses. In addition, numerous resumes are of dissimilar formats—some being plain text and others being artfully drafted with tables, graphics, or columns—which adds to the difficulty of extracting structured data promptly. Crucial information regarding a candidate's qualifications, skills, or accomplishments could be located deep in the document and miss the eye altogether in manual review.

To overcome these limitations, this project suggests a smart, automated Resume Analyzer Tool that harnesses technologies including Natural Language Processing (NLP), machine learning algorithms, and data visualization with Python. The primary objective of this tool is to extract meaningful information from resumes, analyze the data, and present actionable insights in a clear and efficient manner. It is designed to serve various types of users, including companies, educational institutions, and individuals involved in recruitment or career guidance.

One of the fundamental aspects of this system is resume parsing—a method that leverages NLP to extract structured information automatically from unstructured resume text documents. It extracts major details like the name of the applicant, contact details, skills, experience, education, certifications, and so on. After the data is extracted, machine learning algorithms are used to assess the candidate's qualifications and match them with suitable job positions. The system also calculates a resume score, forecasts the candidate's level of expertise, and suggests courses, certifications, or competencies the candidate could possibly be required to enhance their chances of employment.

On the candidate's side, individuals are able to upload their resumes into the system. It will automatically give them a summary of their fundamental facts, sets of skills, levels of experience, and tailored suggestions. The tool also provides resume tips and handpicked video tutorials for interview preparation to assist candidates in enhancing not only their resumes but also their employability.

On the administrative front, the system keeps all applicant information in a well-structured MySQL database, making it easy for recruiters or HR managers to access. They can export applicant information in CSV format, see statistics through graphical dashboards generated via Python data visualization libraries such as Plotly, and sift through candidates based on parameters. The admin dashboard also contains graphical summaries like pie graphs of anticipated job positions and user experience levels, timelines of applicant activities, and maps showing peak application periods.

The suggested tool is better than the manual method in that:

- It is faster, saving resume screening time considerably.
- More efficient and unbiased, reducing human prejudice.
- Scaling, processing hundreds of resumes at a time.
- More insightful, providing hints and trends missed by manual screening.

The software is built with Python 3, where Streamlit handles the frontend as well as backend. It employs basic libraries such as pandas, numpy, pyresparser, pdfminer, and plotly to handle data processing, parsing, and visualization. The software uses basic hardware, internet connectivity, and access to a shared network in case more than one user needs to connect.

## RELATED WORK

Before developing any new system, it is essential to study existing research, tools, and technologies in the same domain. For this project, the key areas of interest are resume parsing, job-role matching, and data visualization. Each of these fields has seen significant development over time. Below is a summary of the current state of the art in each area and the gaps that still exist.

### 1. Resume Parsing using NLP

Resume parsing is the foundational step in any automated resume processing system. Early systems used rule-based methods, relying on manually written patterns and regular expressions to extract details such as names, emails, phone numbers, and skills. While useful for structured documents, these systems were fragile and failed on resumes with unusual formatting or creative layouts.

With the rise of Natural Language Processing (NLP), more sophisticated approaches were developed. Libraries like spaCy introduced Named Entity Recognition (NER) models that could identify entities such as person names, organizations, degrees, job titles, and skills from free-form text. These models significantly improved the accuracy and flexibility of resume parsing by reducing reliance on rigid templates. They can handle resumes with varying structures, styles, and formats, including those with unconventional headings or wording.

### 2. Job Matching using Machine Learning

After extracting resume information, the next step is to match the candidate to suitable job roles. Earlier systems performed keyword-based matching—if a resume contained keywords like “Python,” “SQL,” or “React,” it would match a software developer job. However, these methods lacked semantic understanding and failed to recognize variations or synonyms.

Machine learning helped overcome these limitations. Models trained on historical recruitment data allowed for more context-aware classification. Techniques like TF-IDF and word embeddings (e.g., Word2Vec, GloVe) helped systems understand that terms like “developer” and “engineer” are semantically similar. More advanced models such as Random Forests and Support Vector Machines (SVMs) have been used to classify resumes into domains like IT, Management, or Design, based on the overall profile and content.

### 3. Resume Visualization

Once resumes are parsed and analyzed, presenting the information effectively becomes critical. Instead of reading through long-form text, recruiters can benefit from visual dashboards that summarize key data. Graphs, charts, and timelines make it easier to compare candidates at a glance.

While tools like Power BI and Tableau are commonly used for visualization, they often require separate setup and may not integrate directly with the parsing or analysis components. For this project, Python-based libraries like Plotly and Matplotlib are used to create interactive, real-time visualizations that are seamlessly integrated into the application using Streamlit.

### 4. Gaps Found

Despite advancements, many systems still fall short in key areas:

- **Lack of Integration**: Most tools focus only on one aspect either parsing, analysis, or visualization without providing an end-to-end solution.
- **Static Dashboards**: Many dashboards are not dynamic and don’t update automatically as new data is added.
- **Creative Resume Handling**: Resumes with non-standard formats, images, or graphic elements still pose challenges for parsing and visualization tools.

Recognizing these limitations, this project offers a complete pipeline that handles parsing, analysis, and visualization within a single system—built using Python and Streamlit—to provide a more efficient and scalable recruitment solution.

## METHODOLOGY

The development of this tool followed a systematic approach divided into five core stages: dataset preparation, resume parsing, analysis, machine learning-based classification, and interactive visualization.

### 1. Dataset Preparation

A collection of **500 resumes** in both PDF and DOCX formats was used.
The tool extracts the following structured fields:

- Name
- Contact Information
- Skills
- Work Experience
- Education
- Certifications
- Projects

**2. Resume Parsing**

Tools and libraries used:

- PyMuPDF and pdfminer for reading PDF files.
- docx2txt for extracting text from Word documents.
- spaCy for Named Entity Recognition (NER).

These tools automatically extract structured data from raw, unformatted resume documents.

**3. Resume Analysis**

**Skill Gap Analysis**: Extracted skills are compared against predefined job role requirements to identify missing or desirable skills.

**Resume Scoring**: Each resume is assigned a relevance score based on factors like:

- Skill-job match ratio
- Years of experience
- Education level
- Certifications

**4. Machine Learning Models**

These models classify resumes into domains such as IT, Finance, Marketing, Management, and Design.

**5. Visualization**

All visualizations are implemented using **Python libraries**, primarily:

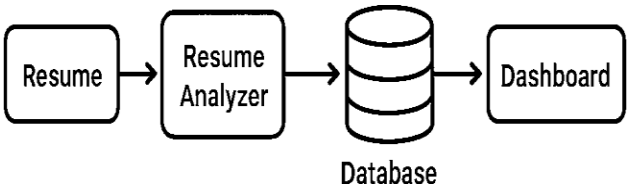
- **Plotly** – for interactive graphs and dashboards
- **Matplotlib** – for static visualizations

Visual components include:

- **Skill distribution**
- **Most common job roles predicted**
- **User's Experience levels**
- **Resume score**
- **User's Ratings**
- **Pie charts** for domain and experience segmentation
- **Feedback** Pie chart

This methodology ensures that the system is robust, accurate, and user-friendly, providing both applicants and recruiters with a powerful tool for modern hiring needs.

## SYSTEM ARCHITECTURE

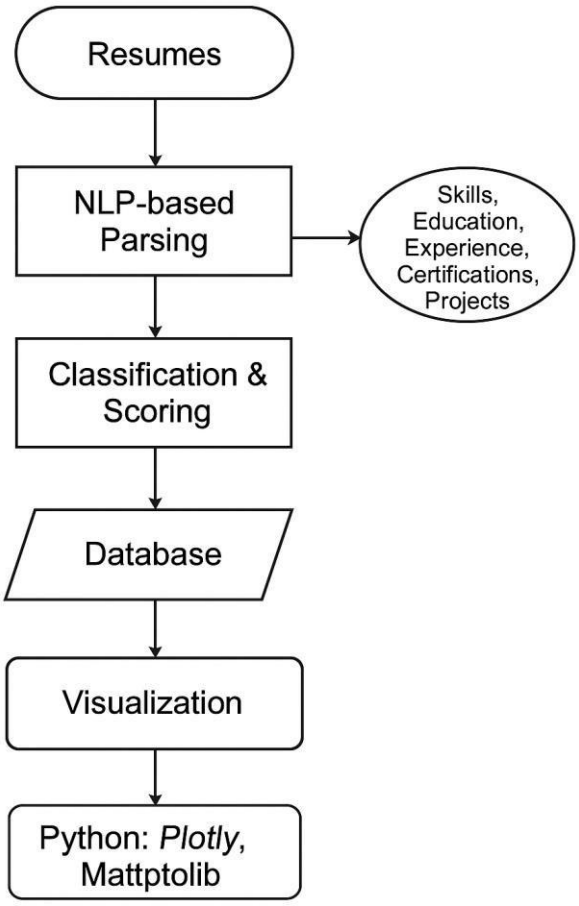


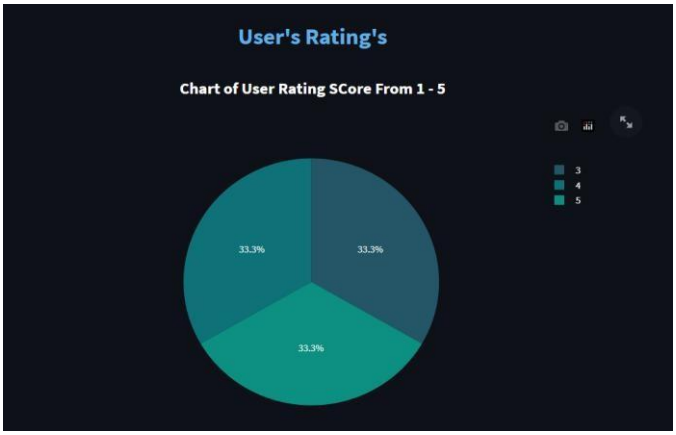

In this project, resumes are collected and automatically processed to extract key information such as skills, educational background, work experience, certifications, and project details. The first step involves cleaning and parsing the resumes using Natural Language Processing (NLP) techniques, which help convert unstructured text into structured, machine-readable data.

Once the data is extracted, it is analyzed to score and classify each resume based on multiple criteria, including how well the candidate's skills match the job requirements, their level of experience, and education. The structured output is then saved to a MySQL database, making it easy to access, query, and analyze over time.

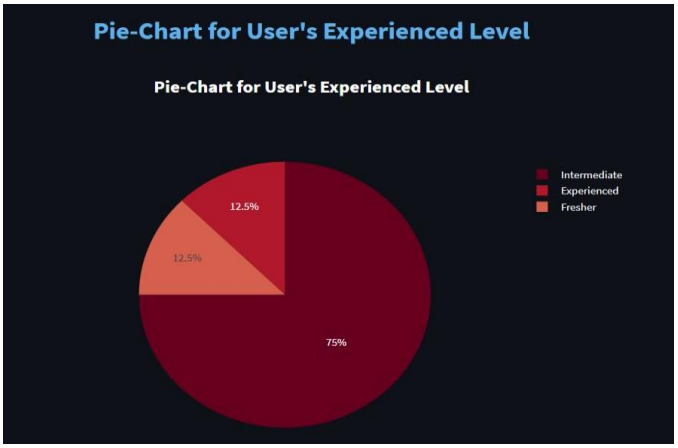
To present this data in an insightful and interactive manner, we use Python libraries such as Plotly and Matplotlib to generate visual dashboards. These dashboards showcase important trends like skill distribution, experience levels, resume scores, and candidate comparisons—all of which help recruiters quickly identify and shortlist top candidates.

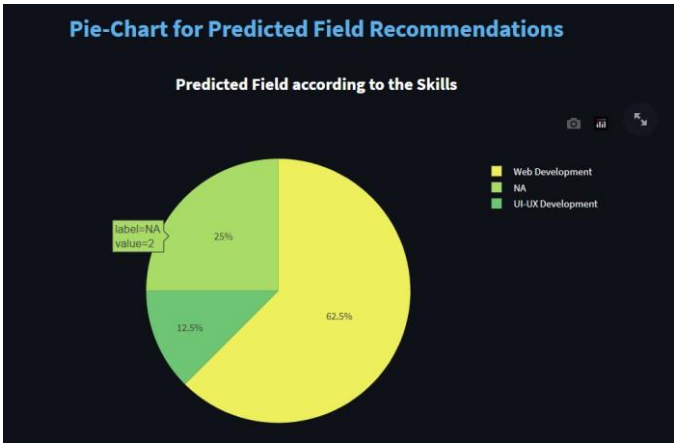
Additionally, resumes that are incomplete or formatted in a way that prevents proper parsing are automatically flagged, allowing administrators to review them separately or request corrections. This complete end-to-end system significantly reduces manual workload, increases shortlisting accuracy, and brings more fairness and consistency to the hiring process.








## RESULT AND ANALYSIS

| Metric | Value |
|---|---|
| Resume Parsing Accuracy | 90% |
| Resume Classification Accuracy | 89% |
| Shortlisting Speed Improvement | 40% faster |
| Dashboard Refresh Time | 8-10 seconds |

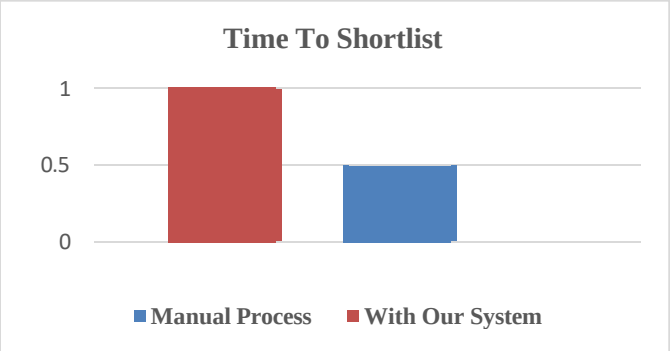
- Recruiters were able to shortlist candidates 2x faster than manual review.
- Filters based on education, skill sets, and years of experience worked smoothly and allowed for quick narrowing of candidate pools.
- The resume score ranking made it easy to prioritize top candidates without reading every document.
- The real-time dashboard automatically refreshed when new resumes were uploaded, maintaining up-to-date insights.

## CONCLUSION

This project presents a modern, efficient, and intelligent approach to resume screening by combining Natural Language Processing (NLP), Machine Learning (ML), and Python-based data visualization. By automating the parsing and analysis of resumes, the system significantly reduces the time and effort required in traditional manual recruitment processes.

It not only extracts critical information like skills, education, and experience from resumes but also evaluates and scores each candidate based on how well they match job requirements. The use of interactive Python dashboards makes it easier for recruiters to visualize and compare candidate profiles, improving decision-making speed and accuracy.

Applicants benefit as well they receive feedback, recommendations, and even tips to enhance their resumes and increase their chances of getting shortlisted. Meanwhile, incomplete or non-standard resumes are flagged for manual review, ensuring fairness and accuracy throughout the process.
Overall, this tool streamlines recruitment, saves time, reduces bias, and offers a scalable solution for organizations of all sizes. It's a step forward in making hiring smarter, faster, and more data-driven.

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