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AI-based resume screening system for automated hiring

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Abstract

The hiring process is undergoing a digital transformation as companies seek efficient methods to manage the growing volume of job applications. Traditional manual resume screening is labour-intensive, inconsistent, and often influenced by unconscious biases. This paper presents an AI-based resume screening system that leverages Natural Language Processing (NLP) and Machine Learning (ML) techniques to streamline recruitment. The system is designed to parse and analyze resumes, match them with job descriptions, and provide a ranked list of suitable candidates. The approach involves structured data extraction, semantic comparison using word embeddings, and scoring based on relevance, experience, and skill match. Training data is derived from historical recruitment records to build predictive models that improve over time. Unlike keyword-based filtering, this system understands context and semantics, enabling more accurate candidate evaluation. It also adapts through a feedback loop, incorporating recruiter preferences to enhance future recommendations. Implementing such AI-based systems not only speeds up the recruitment cycle but also reduces operational costs and improves hiring quality. The proposed system is particularly beneficial for large organizations and recruitment agencies handling high application volumes. Results from experimental validation demonstrate significant improvements in accuracy, efficiency, and fairness compared to traditional methods. Future enhancements may include video analysis for interviews and integration with applicant tracking systems. This paper outlines the system architecture, methodology, and practical applications, offering a transformative approach to talent acquisition in the era of artificial intelligence.

Keywords: Artificial intelligence, resume screening, recruitment automation, machine learning, natural language processing, candidate ranking, hiring technology

Introduction

Hiring the right talent is one of the most critical functions for any organization. However, the process of sifting through hundreds or thousands of resumes to find suitable candidates is often inefficient and susceptible to human error. As job applications move online and the use of job portals grows, human resource (HR) departments are increasingly overwhelmed by the volume of resumes received. Traditional screening methods, based on manual reading or basic keyword filters, frequently result in missed opportunities and biased decisions. To address these issues, the adoption of Artificial Intelligence (AI) in recruitment has emerged as a powerful solution.

AI has the potential to transform the recruitment process by automating resume screening, identifying the most qualified candidates, and minimizing human biases. Through the use of NLP and ML algorithms, AI systems can understand resume content, assess candidate qualifications, and match them with job descriptions more accurately than manual methods. These systems are capable of semantic analysis, meaning they can detect variations in language and context, offering a more holistic view of each applicant's capabilities.

This paper presents a comprehensive AI-based resume screening system designed to streamline hiring. It focuses on intelligent resume parsing, feature extraction, candidate-job matching, and continuous learning from recruiter feedback. The goal is to reduce screening time, increase fairness, and enhance decision-making. The rest of the paper is structured as follows: related work is reviewed, system architecture is proposed, methodology is detailed, experimental results are discussed, and applications and advantages are highlighted.

Literature Review

The integration of Artificial Intelligence in Human Resource Management, particularly in recruitment, has received considerable attention in recent years. Traditional recruitment

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systems such as Applicant Tracking Systems (ATS) primarily rely on keyword-based search mechanisms. While they offer basic automation, their inability to understand semantic meaning and context often results in poor matching accuracy^[1].

A significant improvement in resume screening was achieved with the adoption of Natural Language Processing (NLP). Jain *et al.*^[2] presented a system that used tokenization, part-of-speech tagging, and named entity recognition to extract critical information from resumes and align it with job descriptions. However, the lack of semantic understanding in early NLP approaches limited their effectiveness.

With the rise of deep learning, embedding-based models such as word2vec and BERT have become mainstream in resume-job matching. Agarwal^[3] proposed a semantic similarity model using BERT embeddings, which outperformed TF-IDF in identifying skill-based relationships between resumes and job requirements. Similarly, Singh and Joshi^[4] demonstrated the effectiveness of word embeddings in matching synonyms and domain-specific terminologies that traditional methods often overlook.

Bias mitigation has also been explored in AI recruitment systems. Liu and Liu [5] conducted a comprehensive review and emphasized the need for algorithmic fairness. Their research suggested that bias could be introduced through training data and proposed fairness-aware machine learning models to counteract discriminatory outcomes.

Several commercial platforms like HireVue and Pymetrics have implemented AI-based systems, combining resume analysis with behavioral assessments. These advancements confirm that AI has the potential to bring fairness, efficiency, and scalability to recruitment when implemented responsibly and transparently.

2. Related Work

Resume screening has been a subject of research for over a decade, primarily due to its importance in recruitment and the challenges it presents. Traditional Applicant Tracking Systems (ATS) have been used extensively in HR departments to manage resumes, but their capabilities are limited to keyword filtering and document storage. They often fail to understand context, leading to the rejection of well-qualified candidates who may not use exact keywords. Recent research efforts have focused on enhancing resume screening through the application of NLP and ML. For instance, studies like Jain *et al.*^[1] explored NLP techniques to extract key entities from resumes, such as names, skills, and experiences, and match them with job requirements. Similarly, Liu *et al.*^[2] reviewed the impact of AI on HR management and emphasized the potential of AI to reduce bias and improve efficiency.

Another noteworthy development is the use of semantic similarity models like BERT and word2vec, which allow systems to understand contextual meaning. Singh and Joshi^[3] demonstrated that using semantic embeddings led to more accurate resume-job matches. Agarwal^[4] applied deep learning for resume ranking and showed its effectiveness in identifying soft skills and non-standard resume formats.

Fairness and bias reduction have also been key areas of study. Researchers have proposed fairness-aware algorithms that mitigate bias based on gender, ethnicity, or age in AI models^[5]. These contributions highlight the need for more

intelligent, context-aware systems that go beyond keyword matching to deliver meaningful, equitable results in automated resume screening.

3. System Architecture & Design

The proposed AI-based resume screening system is designed with modular architecture to support flexibility, scalability, and adaptability. It consists of five core components: Resume Parsing, Job Description Analysis, Matching Engine, Ranking Module, and Feedback Learning Loop.

Resume Parsing Module

This module uses NLP techniques to extract structured information from unstructured resume documents. Key details such as name, contact information, education, work history, skills, certifications, and languages are identified using Named Entity Recognition (NER) and POS tagging.

Job Description Parser

The system parses job descriptions provided by recruiters and extracts required qualifications, skills, experience levels, and domain-specific terms. These are converted into a structured format that aligns with the parsed resumes.

Matching Engine

This module compares resume data with job description features using vector-based models like TF-IDF, cosine similarity, and semantic embedding's (e.g., BERT). It calculates similarity scores based on skill overlap, domain expertise, and role-specific keywords.

Ranking Module

Based on similarity scores and weighted criteria (e.g., years of experience, education level, relevant certifications), resumes are ranked in order of suitability. This helps recruiters prioritize the most promising candidates.

Feedback Loop

Recruiter selections and rejections are recorded and fed into a machine learning model to improve future rankings. This allows the system to adapt over time and align better with human judgment.

The architecture supports integration with existing ATS and HR systems via APIs, enabling seamless automation across recruitment workflows.

4. Methodology

The methodology for building the AI-based resume screening system follows a data-driven, iterative approach. The process includes data collection, preprocessing, feature extraction, model training, evaluation, and deployment.

1. Data Collection

A dataset of 2,000 resumes and 200 job descriptions was collected from online job portals. Resumes were obtained in PDF, DOCX, and plain text formats, while job descriptions were scraped from corporate websites.

2. Pre-processing

Text from resumes and job descriptions was cleaned to remove stop words, special characters, and redundant formatting. Tokenization and lemmatization were applied to

standardize text. NLP libraries such as spaCy and NLTK were used.

3. Feature Extraction

TF-IDF vectors were generated for skills, experience, and education sections. Named Entity Recognition was used to extract company names, job roles, and durations. Word embeddings (using word2vec and BERT) captured semantic relationships between terms.

4. Model Training

Supervised machine learning models, including Support Vector Machines (SVM), Random Forest, and Gradient Boosting, were trained using labeled data-i.e., resumes marked as suitable or not for specific roles. Cross-validation ensured generalization.

5. Evaluation

The models were evaluated using metrics such as accuracy, precision, recall, and F1-score. Semantic similarity was validated using benchmark datasets. The best-performing model was deployed into the matching engine.

6. Continuous Learning

The model incorporates feedback from recruiter decisions, retraining itself periodically to improve performance over time.

This methodology ensures a reliable, scalable system capable of handling various industries and job types.

5. Advantages & Limitations

A. Advantages

The integration of Artificial Intelligence in resume screening has transformed traditional recruitment workflows into more efficient, scalable, and intelligent systems. One of the primary advantages is significant time-saving in the initial candidate shortlisting process. AI algorithms can analyze thousands of resumes within seconds, reducing manual labor and enabling recruiters to focus on more strategic tasks.

Another major benefit is improved accuracy and consistency in candidate evaluation. AI models can detect relevant skills, experience levels, and qualifications using Natural Language Processing (NLP), eliminating human biases and inconsistencies that often affect manual screening. AI-based systems also enable semantic understanding, allowing them to match resumes that use different terminology but possess equivalent competencies.

Furthermore, such systems can be customized to different industries, job roles, and organizational requirements. Through machine learning, they continuously improve with feedback and data, becoming more efficient over time. Scalability is also a notable benefit, especially for organizations receiving large volumes of applications.

B. Limitations

Despite its advantages, AI-based resume screening is not without challenges. The risk of algorithmic bias is a major concern. If the training data includes biased hiring practices, the AI system may unintentionally replicate or amplify these biases, leading to unfair outcomes.

Another limitation is the lack of context understanding in some cases. While NLP has improved, AI may still struggle with nuances in career gaps, diverse job roles, or

unconventional career paths. Additionally, applicants using optimized resume formatting or keyword stuffing may unfairly rank higher despite being less qualified.

Lastly, transparency and explainability of AI decisions remain problematic. Many systems operate as black boxes, making it difficult for recruiters or applicants to understand why a particular decision was made, raising ethical and regulatory concerns.

6. Application

AI-based resume screening systems are widely applicable across various industries and organizational structures, particularly where high-volume recruitment is essential. One of the most prominent applications is in large enterprises and multinational corporations that receive thousands of applications for a single job opening. AI systems streamline the initial screening by automatically filtering candidates based on skillset, experience, and job role compatibility.

These systems are also useful for recruitment agencies and staffing firms that handle recruitment for multiple clients across domains. By employing AI-driven tools, agencies can reduce turnaround time, enhance match accuracy, and increase client satisfaction through data-driven candidate recommendations.

Another important application is in campus hiring and university placement cells, where bulk resume evaluations are necessary within a limited time frame. AI tools can rapidly assess student resumes, match them to available job roles, and provide a ranked list of suitable candidates, making the process more efficient and transparent.

Start-ups and small-to-medium enterprises (SMEs) benefit from AI screening by reducing human resource overhead. These organizations often lack dedicated HR teams and can use AI systems to automate early-stage screening, allowing them to focus on final interviews and onboarding.

Moreover, AI resume screening is being integrated into end-to-end Human Resource Management Systems (HRMS) and Applicant Tracking Systems (ATS), providing a centralized platform for job posting, resume parsing, candidate ranking, and communication.

Lastly, government and public sector recruitment bodies are exploring AI-based tools for transparent, unbiased hiring practices, ensuring compliance with fair recruitment standards and improving public trust in the hiring process.

7. Conclusion

The increasing complexity and volume of recruitment processes in the digital age necessitate intelligent automation, and AI-based resume screening systems have emerged as a transformative solution. By leveraging technologies such as machine learning, natural language processing, and semantic analysis, these systems provide scalable and efficient alternatives to traditional manual screening methods. They enable organizations to identify the most suitable candidates quickly, reduce time-to-hire, and minimize human biases that may affect fairness and transparency in hiring.

The implementation of AI in resume screening offers notable advantages, including speed, accuracy, and the ability to handle large datasets. Furthermore, such systems can adapt to diverse recruitment needs, offering a customized approach based on job descriptions, required skills, and organizational priorities. However, it is also important to recognize and address the limitations, such as

algorithmic bias, context misinterpretation, and a lack of transparency in decision-making processes.

To ensure ethical and responsible AI adoption in recruitment, future research should focus on enhancing explain ability, mitigating bias, and developing standardized benchmarks for evaluating AI hiring systems. The integration of human oversight in AI workflows will be crucial to maintaining balance and accountability.

In conclusion, while AI-based resume screening is not a complete replacement for human judgment, it significantly enhances the recruitment process when used appropriately. As organizations continue to digitize their HR operations, the adoption of AI tools in hiring will play a pivotal role in creating smarter, fairer, and more efficient recruitment ecosystems.

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