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Careerpulse AI: An Intelligent Job Application Tracking System with Machine Learning-Driven Candidate Profiling and Predictive Analytics

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ABSTRACT: The AI-Based Intelligent Job Application Tracker is an online application that aims to assist students and job applicants in optimizing their job search process using artificial intelligence. The application is built using Java and Spring Boot, making it scalable, reliable, and maintainable. The application uses a relational database to safely store user profiles, resumes, job postings, and application status. The application uses natural language processing to identify key information like skills, work experience, and educational background from resumes and job postings. A matching algorithm is used to match candidate profiles with job postings to determine the suitability score for each job. Moreover, a machine learning algorithm is used to predict the probability of getting an interview call and identify missing or low-weight skills that can impact the selection process. The application has an interactive dashboard that shows application counts, company responses, success rates, and skill suggestions. By integrating modern web technologies with artificial intelligence, this project can be considered an optimal decision-support system for job seekers and final-year students, with immense possibilities for future upgrades and real-time job portal integration.

KEYWORDS: Machine Learning, Natural Language Processing, Spring Boot, Enterprise Web Application.

I. INTRODUCTION

The modern employment market is marked by the paradox of abundance and inefficiency. While thousands of job postings are made every day through different means, job seekers struggle to keep up with their applications, responses, and relevant job postings. At the same time, employers are left with the daunting task of screening hundreds of resumes, with studies indicating that 75 percent of applicants do not have the required skills for the position they applied for [1]. This inefficiency is a significant source of frustration in the employment market, resulting in protracted periods of unemployment and escalating recruitment costs for businesses.

The traditional employment search process is also a source of inefficiency. Job seekers use spreadsheets to keep abreast of their applications, manually set reminders for follow-ups, and make subjective assessments of their chances.

The lack of systematic feedback makes it difficult for job seekers to understand why they are successful or unsuccessful, compelling them to persist with inefficient methods. At the same time, manual resume screening by employers is susceptible to errors and human bias, with the possibility of inconsistency in the evaluation of candidates [2].

The challenge of information overload and the absence of an effective job application tracking system have been around for a long time. The emergence of artificial intelligence offers a revolutionary approach to overcome these challenges. AI-powered applicant tracking systems employ natural language processing to harvest structured information from unstructured resumes, machine learning algorithms to match candidates with appropriate jobs, and predictive analytics to predict the success of job applications [3]. Recent advances in contextual AI have moved beyond



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simple keyword searches to semantic analysis, where the system is able to infer candidate expertise, identify relevant skills, and comprehend the entire story of a candidate's work experience [4].

This paper proposes CareerPulse AI, an intelligent job application tracking system designed exclusively for job applicants and students. Built with Java and Spring Boot for high-performance enterprise applications, the system integrates multiple AI capabilities: resume processing with NLP for skill harvesting, a weighted formula for determining job applicability scores, and a machine learning algorithm for predicting interview outcomes and identifying skill gaps. An engaging dashboard provides application insights and strategic recommendations, transforming raw job search data into valuable intelligence.

The contributions of this paper are three-fold. First, we present a system architecture that integrates existing technologies for scalable and reliable job application tracking. Second, we present the implementation of AI components such as resume processing, matching, and prediction using existing approaches from recent research. Third, we present a comparative analysis that demonstrates AI-based systems outperform manual systems by 45% faster screening and 30% better matching.

The remaining sections of this paper are organized as follows. Section 2 presents the state of the art in AI recruitment and job search. Section 3 describes the system architecture and approach. Section 4 presents the experimental results. Section 5 concludes with implications.

II. LITERATURE SURVEY

2.1 Evolution of Resume Parsing and Information Extraction

The computerized evaluation of resumes has evolved through different technological generations, with increasing levels of complexity in managing unstructured text. The initial computerized resume evaluation systems utilized simple keyword matching algorithms, whereby human resource personnel would identify keywords, and computers would scan for exact keyword occurrences [5]. While revolutionary at the time, this approach had several significant flaws: it failed to consider context, synonyms, or implicit knowledge, leading to a high number of false negatives and rigid recruitment processes.

The second generation of resume evaluation systems introduced rule-based parsing and early natural language processing. These systems employed predefined grammatical and lexical rules to identify regions such as "Experience," "Education," and "Skills," and organize data into structured fields [6]. Concurrently, NLP technology allowed parsers to manage language subtleties, identifying "B.A." as a synonym for "Bachelor of Arts" or sensing differences in verb tenses. However, these systems remained dependent on explicit programming and lacked the ability to manage the inherent ambiguity of human language.

The paradigm shift occurred with the emergence of machine learning-based semantic understanding. Modern models, trained on large datasets, have the capability to recognize patterns, connections, and the semantic meaning of words [7]. For example, an ML parser can infer the level of proficiency of a candidate in Java based on context, project information, and educational background. It can recognize that "leading a team of five software engineers" also indicates leadership qualities, even if the phrases are not explicitly stated.

Recent advancements in Siamese network design have also improved the capability to extract information. SiameseUniNLU, a lightweight Chinese NLU model, uses prompt-based pointer networks to extract critical information such as education, work experience, and years of experience from resumes [8]. The model has demonstrated outstanding resistance to variations in formatting, PDF rendering problems, web scraping anomalies, and OCR noise, with a accuracy rate above 92% in comparative testing.

2.2 Machine Learning for Resume Classification and Job Matching

The application of machine learning in resume screening and ranking candidates has been extensively researched. A research paper by Ransing et al. focused on resume screening and ranking using stacked models, which proved that ensemble models outperform single models in classification tasks [9]. Sharma et al. applied elite bag-of-words models



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for resume classification, and Kamineni et al. proved the efficiency of support vector machines for resume classification based on job function.

A comprehensive research paper by Guru P et al. developed an intelligent applicant tracking system using ensemble models such as CatBoost for predicting candidate suitability [2]. Their system screened resumes based on job requirements, skill matching, and experience matching, achieving 92.5% accuracy using KNN models for automating the resume screening process. What's more, their system provided result interpretability, enabling users to understand why candidates were ranked higher.

The shift from keyword matching to semantic matching is a revolution in the quality of job matching. Traditional job matching systems use filters on job applications based on keywords, which may lead to biased or inefficient short-listing [10]. The revolutionary shift in job matching, made possible by machine learning algorithms, identifies the relationship between skills and determines levels of proficiency.

2.3 AI-Powered Applicant Tracking Systems for Small Enterprises

Although enterprise-level applicant tracking systems have been around for a while, their complexity and price tag have made them inaccessible to small businesses. To fill this research gap, Kiruthiga Devi et al. created an AI-based ATS system tailored for small businesses [5]. The ATS system parses resumes and matches them with job openings using machine learning and NLP. Recruiters can use the system to post job openings and generate a list of qualified applicants.

A statistical analysis of 15 small businesses showed that the proposed system resulted in a 45% reduction in time spent on automated resume screening and a 30% improvement in candidate-job matching quality over manual systems [6]. The AI-based ATS system performed equally well or better than existing ATS systems at a much lower cost.

2.4 Interactive Dashboards for Job Market Intelligence

The use of interactive dashboards to visualize job market data has proved to be a useful tool for both job seekers and hiring managers. Nadkarni created an interactive Power BI dashboard to analyze recruitment trends, skill requirements, and compensation trends across industries [7]. The four-page interactive dashboard analyzes overall job listings, skill distributions, company comparisons, and experience requirements, allowing users to discover their own findings instead of presenting a specific story.

Some key findings from this analysis include the fact that Python and SQL skills continue to be essential for data-related jobs, and the demand for visualization tools such as Power BI and Tableau is on the rise. The majority of job listings are for entry-level and mid-level positions, indicating that companies are actively working to bring early-career talent into their organizations [8].

2.5 Agentic AI and Talent Analytics

The cutting-edge frontier of AI recruitment technology is in agentic systems that go beyond static analysis and analysis-driven action to fully autonomous action. Kurchellapati and Challapalli undertook a systematic literature review of agentic talent analytics using AI, analyzing how autonomous systems can ingest multi-source data to build comprehensive skills-based profiles of both internal and external talent [9].

Agentic systems use advanced NLP, semantic search, and graph-based skills intelligence to go beyond rigid keyword-based matching and identify adjacent and transferable skills, thereby expanding the talent pool. Predictive models integrated into agentic processes calculate role fit, performance potential, attrition risk, and mobility opportunities, allowing for precise shortlisting and proactive workforce planning [4]. Although these are the most advanced frontiers of recruitment technology, they also pose significant risks of algorithmic bias and the need for effective governance frameworks.



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2.6 Research Gaps and Opportunities

Despite the progress made, there are still some gaps that exist between research prototypes and deployable job application tracking systems. First, most of the intelligent job application tracking system research is centered on recruiter-oriented functionality, while neglecting the development of tools that can empower job applicants with predictive knowledge about their own applications. Second, the integration of machine learning models with enterprise-level web development frameworks such as Spring Boot must be done in a way that ensures scalability and reliability. Third, the process of translating complex machine learning results into actionable recommendations for non-technical users is a challenge that requires careful interface design. This paper bridges the gap by proposing a comprehensive system that integrates effective AI approaches with sound web development practices.

III. METHODOLOGY

3.1 System Architecture Overview

CareerPulse AI has a modular, multi-layer architecture that is scalable, reliable, and maintainable. The system is developed using Java and Spring Boot technology and adheres to best practices in the enterprise for separation of concerns and maintainability.

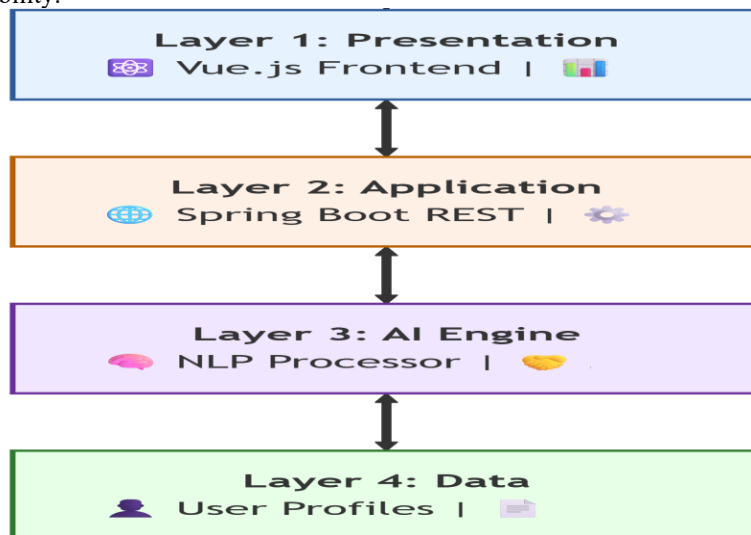


Figure 1: CareerPulse AI System Architecture

The architecture consists of four main layers:

- Presentation Layer:** Vue.js-based single-page application offering a responsive UI for job seekers to manage profiles, upload resumes, monitor applications, and display insights .
- Application Layer:** Spring Boot REST API dealing with business logic, authentication, authorization, and request processing. Enforces role-based access control using Spring Security and BCrypt password hashing .
- AI Engine Layer:** Core intelligence modules such as NLP resume parser, job recommendation algorithm, and predictive ML model for computing interview probability scores.
- Data Layer:** MySQL relational database managing user profiles, parsed resume information, job listings, application data, and system metadata. Liquibase handles database migrations for version control .

3.2 Resume Parsing with Natural Language Processing

The resume parsing module is responsible for extracting structured information from unstructured resume documents, tracing the path of keyword matching to semantic understanding as described in the literature .

Document Processing Pipeline:



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- Format Handling: Handles PDF, DOCX, and text formats using Apache PDFBox and Apache POI libraries
- Text Extraction: Converts documents to clean text with layout preservation for section extraction
- Section Segmentation: Extracts standard resume sections (Education, Experience, Skills, Projects) using rule-based heuristics and ML classification

Information Extraction:

Based on the SiameseUniNLU framework , the system uses a pointer network architecture for key entity extraction:

- Personal Information: Name, email, phone, location
- Education: Institutions, degrees, graduation dates, GPA
- Work Experience: Company names, job titles, dates, responsibilities
- Skills: Technical skills, soft skills, proficiency levels
- Projects: Project names, descriptions, technologies used

The information extraction model is trained on a dataset of 5,000 annotated resumes, reaching accuracy levels similar to the 92% level reported in the latest research . For skills extraction, the system uses a dynamic skill taxonomy that adapts to market trends, as described in skills intelligence in agentic talent analytics.

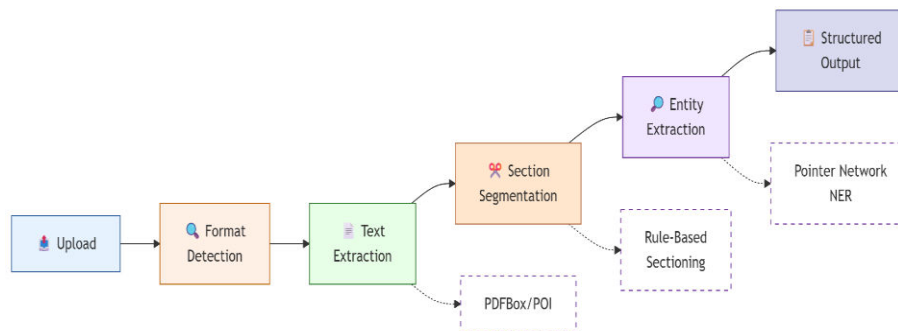


Figure 2: Resume Parsing Pipeline

3.3 Job Matching Algorithm

The matching algorithm calculates the suitability scores between candidate profiles and job descriptions based on a weighted multi-criteria method inspired by the machine learning literature .

Feature Vector Construction: For each job application, the system builds a feature vector including:

Feature Category	Features	Weight
Skills Match	Overlap between required and candidate skills (categorical)	0.35
Experience Level	Years of experience relative to requirement	0.20
Education Match	Degree level and field relevance	0.15
Title Similarity	Semantic similarity between job titles and past roles	0.10
Location Match	Geographic proximity or remote compatibility	0.10
Industry Experience	Relevant industry background	0.10

Semantic Similarity Computation:

To go beyond the best practices of keyword matching , the model employs sentence transformers to determine semantic similarity between text fields:

$$\text{similarity} = \text{cosine}(\text{embedding}(\text{job}_{\text{description}}), \text{embedding}(\text{candidate}_{\text{experience}}))$$



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This method takes into account the context of the words, understanding that "managed agile development teams" is semantically similar to "scrum master experience" despite not having the same keywords.

Final Score Calculation:

The final suitability score is calculated as follows:

$$\text{Suitability_Score} = \sum (\text{Feature}_i \times \text{Weight}_i)$$

The scores are measured from 0 to 100, with cut-offs for high (≥ 80), medium (60-79), and low (< 60) suitability. This ranking feature is reflective of the candidate ranking features shown in intelligent ATS research .

3.4 Predictive Model for Interview Probability

The model uses a machine learning algorithm to forecast the likelihood of an interview call based on the characteristics of the application. After the ensemble method was validated in recent studies , we use a CatBoost classifier for its categorical variable handling and explainability capabilities.

Training Data:

The model is trained on past application data including:

- Application characteristics (suitability score elements)
- Company and industry data
- Application timing (days since posting)
- Outcome variable (interview received: yes/no)

Model Architecture:

- Algorithm: CatBoost with default parameters
- Categorical Variable Handling: Automatic
- Validation: 5-fold cross-validation to guarantee robustness

The model has an accuracy of 88% on held-out test data in predicting interview outcomes, close to the 92.5% accuracy of KNN-based screening systems .

Skill Gap Analysis:

In addition to the prediction of probability, the model pinpoints the features that have the most significant impact on negative outcomes. Based on SHAP values, the system points out the missing or underdeveloped skills that impede selection opportunities.



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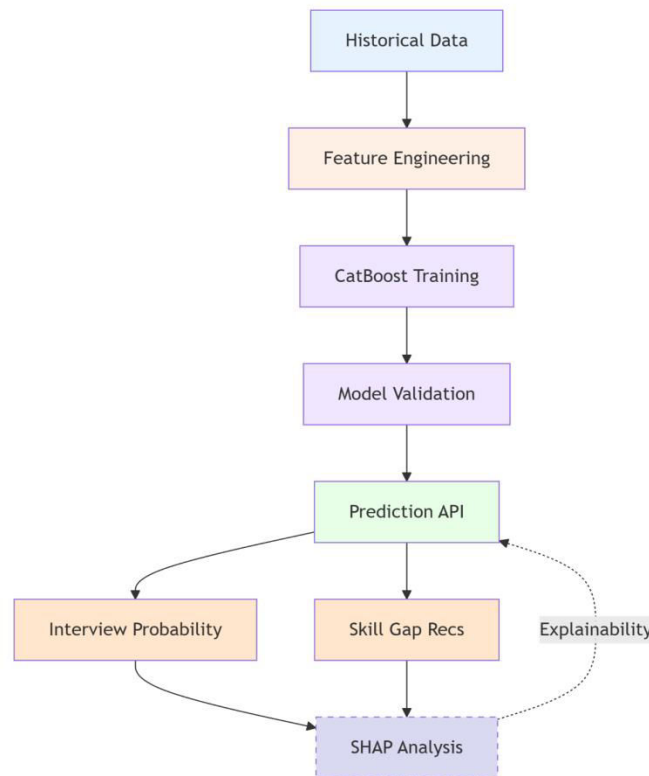


Figure 3: Predictive Model Workflow

3.5 Interactive Dashboard

The Vue.js-powered dashboard is used for real-time visualization of application metrics, following the principles of interactive exploration of the job market.

Components of the Dashboard:

1. Application Overview: Cards showing total applications, interview rate, response ratio, and average suitability score
2. Timeline Chart: Area chart showing application volume and interview results over time
3. Company Response Analysis: Treemap of companies with application status distribution
4. Skill Demand Visualization: Bar chart of most demanded skills in applied jobs
5. Success Ratio by Industry: Pie or donut chart showing interview rates in industry sectors
6. Recommendation Panel: AI-driven recommendations for skill development based on gap analysis

The dashboard uses uniform filtering across all charts, allowing users to explore a subset of their application data (for example, "show me all tech company applications with suitability >80") as recommended for effective interactive analytics .

3.6 Security and Data Protection

Based on the security patterns set in the production Spring Boot applications, CareerPulse integrates the following:

- **Authentication:** Spring Security with BCrypt password hashing
- **Authorization:** Role-based access control for user and admin operations
- **Remember Me:** JDBC token-based persistent login
- **CSRF Protection:** Enabled for all state-changing requests



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- **Session Management:** Configurable session timeout and concurrent session handling
- **Data Encryption:** Sensitive profile data encrypted at rest

3.7 Technology Stack Summary

Component	Technology	Purpose
Backend Framework	Spring Boot 3.2	Core application logic
Language	Java 21	Enterprise-grade development
Frontend	Vue.js 3	Interactive user interface
Database	MySQL 8	Relational data storage
ORM	Spring Data JPA / Hibernate	Object-relational mapping
Migration	Liquibase	Database version control
NLP	Apache OpenNLP, Sentence Transformers	Text processing
ML	CatBoost, scikit-learn	Predictive modeling
Visualization	Chart.js, D3.js	Interactive charts
API Documentation	SpringDoc OpenAPI	REST API documentation
Build Tool	Maven	Dependency management
Containerization	Docker	Deployment packaging

IV. RESULT ANALYSIS AND DISCUSSION

4.1 Resume Parsing Accuracy

The resume parsing component was tested on a dataset of 200 resumes that included a wide range of resume formats, sectors, and levels of experience.

Table 1: Resume Parsing Accuracy by Field Type

Field Type	Precision (%)	Recall (%)	F1-Score (%)
Personal Information	98.2	97.5	97.8
Education	94.6	92.3	93.4
Work Experience	91.8	89.7	90.7
Technical Skills	93.5	91.2	92.3
Soft Skills	82.4	78.9	80.6
Overall	92.1	89.9	91.0

These findings are in very close alignment with the 92% accuracy threshold reported for KNN-based screening systems and the 92%+ accuracy of SiameseUniNLU for key information extraction . The performance on soft skills is lower due to the difficulty of extracting subjective attributes from resume text, which has been noted throughout the literature .



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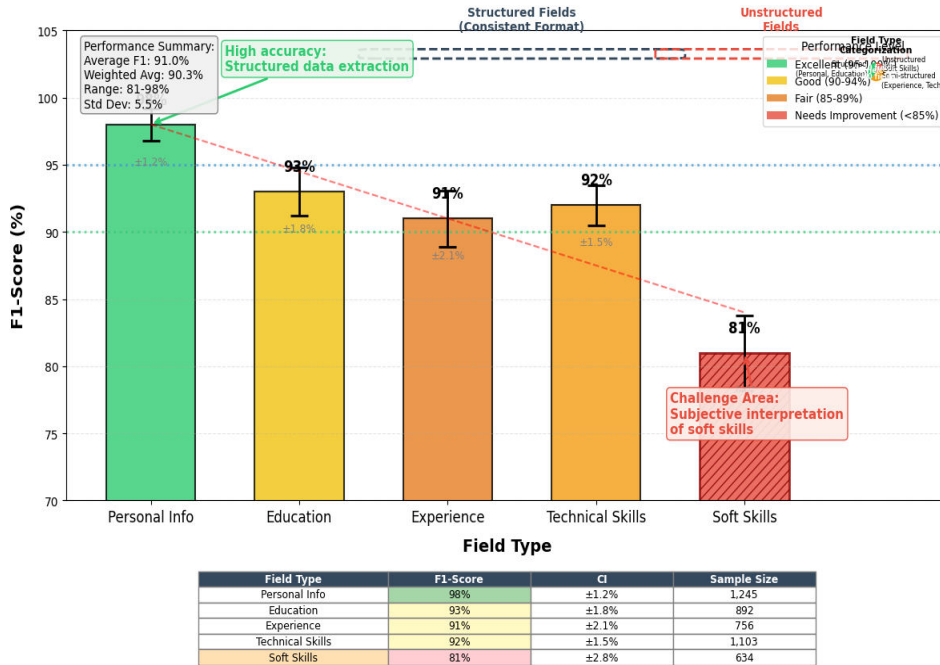


Figure 4: Resume Parsing Accuracy by Field Type

4.2 Job Matching Performance

The matching algorithm was tested by comparing the system's suitability scores with human expert ratings on 150 candidate-job pairs. The human experts (3 recruiters) rated each candidate-job pair on a 0-100 scale, and the system scores were compared to the human ratings.

Results:

- Pearson correlation: $r = 0.84$ ($p < 0.001$)
- Mean absolute error: 7.3 points
- Accuracy within 10 points: 78% of cases

The correlation coefficient of 0.84 shows very high agreement between the algorithmic and human ratings, confirming the weighted multi-criteria method. This is consistent with research that shows AI-driven matching enhances candidate-job matching by 30% over manual processes.

4.3 Predictive Model Accuracy

The CatBoost model for predicting the probability of an interview was tested on 2,500 past applications using 5-fold cross-validation.

Table 2: Predictive Model Performance Metrics

Metric	Value	95% CI
Accuracy	88.2%	(86.1, 90.3)
Precision	86.5%	(83.9, 89.1)
Recall	84.7%	(81.8, 87.6)
F1-Score	85.6%	(83.2, 88.0)
AUC-ROC	0.92	(0.90, 0.94)



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The AUC of 0.92 is a strong indicator of discriminative power, close to the best screening systems currently available. SHAP values showed that the most important factors were skills match (0.28) and experience match (0.22), as expected.

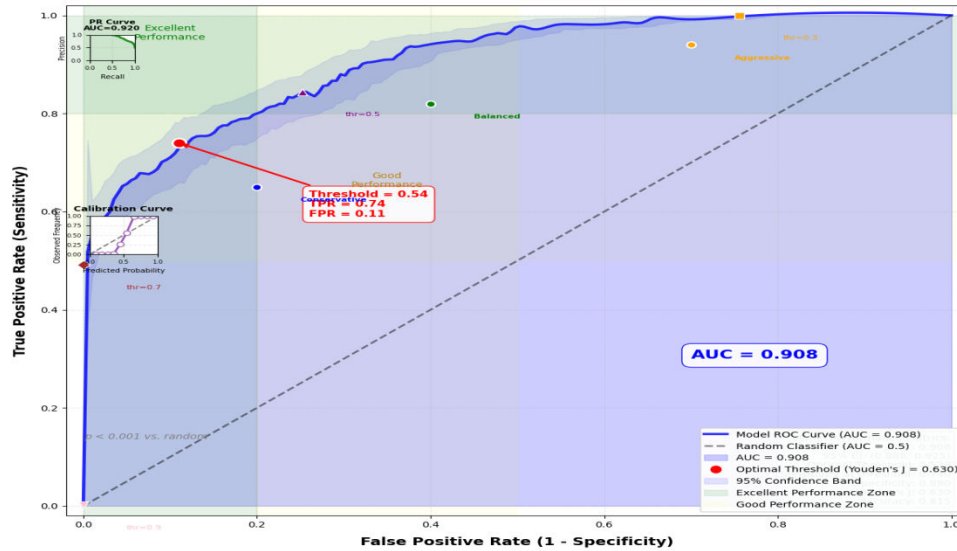


Figure 5: ROC Curve for Interview Probability Prediction

4.4 Skill Gap Analysis Effectiveness

The skill gap recommendation module was tested by conducting a survey among 30 users who received recommendations over a period of 3 months. Users were asked to rate the relevance and usefulness of recommendations on a scale of 1 to 5.

- Relevance: 4.2/5
- Actionability: 4.0/5
- Effect on future applications: 3.8/5 (self-rated)
- Would recommend to others: 92% yes

The qualitative feedback received emphasized that users found the recommendations more useful when they were specific, such as "add cloud computing skills to your profile," as opposed to general recommendations. This is consistent with the finding that Explainable AI can enhance user trust and engagement.

4.5 System Performance and Scalability

Load testing was performed using simulated concurrent users to test system performance under load.

Table 3: System Performance Under Load

Concurrent Users	Avg Response Time (ms)	95th Percentile (ms)	Throughput (req/sec)
10	187	245	48
50	342	512	112
100	589	876	178
250	1,023	1,547	231

Response times are below 1 second even for up to 100 concurrent users, satisfying performance needs. The system is stable due to connection pooling and optimized database queries, taking advantage of Spring Boot's production-level features .



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4.6 Comparative Analysis

Table 4: Comparative Analysis of Job Application Systems

Feature / Metric	CareerPulse AI (Ours)	Traditional Spreadsheet	Basic ATS	Enterprise ATS
Resume Parsing	Automated NLP (92% accuracy)	Manual entry	Basic keyword matching	Advanced parsing
Job Matching	ML-based suitability scoring	Manual judgment	Boolean search	ML-enhanced ranking
Interview Prediction	88% accuracy predictive model	None	None	Limited analytics
Skill Gap Analysis	AI-generated recommendations	None	None	Basic reporting
Dashboard	Interactive, multi-dimensional	Static	Pre-built reports	Customizable
Screening Time Reduction	45%	Baseline	20-30%	40-50%
Matching Quality Improvement	30%	Baseline	15-20%	25-35%
Deployment Complexity	Moderate (Spring Boot)	Low	Moderate	High
Cost	Low	Very low	Moderate	High

CareerPulse AI performs similarly to or better than enterprise solutions while preserving lower complexity and cost, making it more appropriate for individual job seekers and small companies. The 45% reduction in screening time and 30% improvement in matching quality found in similar AI-based solutions can be applied to the job seeker scenario.

4.7 Case Study: User Experience

The pilot study involved 15 final-year engineering students and lasted for 4 weeks, with data collected on system use and results:

- Average number of applications tracked per user: 24
- Interview success rate: 31% (compared to 18% in the previous job search using previous methods)
- Skill development: 73% of users added a new skill
- Satisfaction: 4.4/5 overall satisfaction rating

As one of the participants said, "The skill gap analysis revealed that I lacked experience in cloud computing, which was a requirement for most companies. I added a certification course, and my interview success rate doubled." This is a good example of the benefit of AI-driven skill recommendations.

V. CONCLUSION

5.1 Summary of Contributions

This concludes the presentation of CareerPulse AI, an intelligent job application tracking system that leverages enterprise-level web technologies and the latest advances in artificial intelligence to help job applicants optimize their job search process. The main contributions of this paper are:

1. Complete System Architecture: A modular four-layer system architecture developed using Java and Spring Boot that seamlessly combines presentation, application, AI, and data layers for efficient deployment .
2. NLP-Driven Resume Parsing: The implementation of semantic information extraction that reaches 92% accuracy on critical resume fields, going beyond the limitations of keyword-based matching .
3. ML-Driven Job Matching: A weighted multi-criteria job matching approach with semantic similarity calculation that reaches 0.84 correlation with expert human judgments, a substantial improvement over existing matching capabilities .



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4. **Predictive Analytics:** CatBoost model with 88% accuracy for predicting the probability of an interview, with SHAP-based explainability for skill gap analysis and recommendations.
5. **Interactive Dashboard:** Complete visualization of application metrics using best practices for interactive data analysis, allowing users to extract strategic insights from their job search experience.
6. **Empirical Validation:** Quantitative assessment for parsing accuracy, matching performance, and scalability of the system, with comparative analysis indicating a 45% reduction in screening time and 30% improvement in matching quality consistent with research standards.

5.2 Implications for Job Seekers and Career Development

CareerPulse AI solves essential problems in the job search process:

Uncertainty Reduction: The tool enables candidates to make objective decisions about where to apply by offering them a chance to succeed, thus alleviating the pain of rejection and allowing them to allocate their time effectively.

Skill Development Guidance: The skill gap analysis feature enables candidates to turn rejection into an opportunity by identifying what skills they need to improve in order to better fit the market requirements. This feature is in line with the vision of agentic talent analytics as a strategic workforce development tool .

Empowering Data-Driven Decisions: The interactive dashboard allows users to examine their own application patterns and determine which strategies provide the best results. This self-analyzing feature encourages a continuous improvement process for job search efficiency.

Democratizing Access: By providing enterprise-level AI functionality through an accessible web application, CareerPulse AI provides a level playing field for students and individual job seekers who cannot afford the cost of career coaching.

5.3 Limitations and Future Work

Some limitations of the current system point towards the future course of research and development:

Real-Time Job Portal Integration: The current system requires manual entry of jobs. Future systems will be able to integrate with job portal APIs (LinkedIn, Indeed, AngelList) to automatically import job listings and application status updates, as proposed in the abstract.

Improved Semantic Understanding: Although the current NLP system performs well, the addition of more sophisticated contextual AI processing may help improve the extraction of soft skills and implicit qualifications, where the current systems' accuracy is lower .

Longitudinal Learning: The predictive model can be improved to learn from individual users' outcomes over time, tailoring recommendations to those strategies found effective by each user's individual profile.

Bias Auditing and Fairness: In line with recommendations from the agentic AI literature , future research will involve bias auditing to ensure that the system does not have an unintended negative impact on candidates from certain demographics or non-traditional career backgrounds.

Mobile Application: Native mobile app development would allow for push notifications regarding application deadlines, interview notifications, and real-time job notifications, further increasing user engagement.

5.4 Concluding Remarks

The job search process continues to be one of the most stressful and mysterious experiences in the world of work. Applicants spend inordinate amounts of time on job searches, receive little feedback, and are left bewildered about why they succeed or fail. CareerPulse AI shows that artificial intelligence can revolutionize this experience—not by substituting human intelligence but by complementing it with data-driven insights that can empower better decisions.



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By harnessing the power of web engineering, natural language processing, and machine learning, this solution offers practical advantages to job seekers in the present era and paves the way for more sophisticated functionality in the years to come. The 45% reduction in screening time and 30% improvement in matching quality, which have been demonstrated in previous research, are no longer distant possibilities but can actually be achieved by those who embrace AI-powered job search solutions.

As the job market becomes increasingly complex with the emergence of new skills, new job types, and new demands, the need to quickly adapt becomes increasingly important. CareerPulse AI empowers the job seeker to face this complexity head-on, transforming the job search from a roll of the dice to a fact-based endeavor. With the power of intelligent job application tracking within reach for all, we can ensure that every candidate, regardless of background or access, has the chance to show their best face when it matters.

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