



AI-Based Job Recommendation System Using Skills Analysis

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Abstract:

Recruitment and job matching are very important processes which affect both the recruitment process and the job. Productivity and career development of organizations and individuals.[1],[14] The old-fashioned recruitment methods focus on manually checking resumes, keywording searches, and subjective assessments. Methods that lead to inefficient candidate selection, extended hiring process and inaccurate alignment of jobs with candidates. In order to overcome these limitations, the present paper introduces an AI-based Job Recommendation and Candidate Matching System which automatically recommends jobs to the job seekers based on their CVs and automatically matches them with job applicants, which are generated by the system. Uses Natural Language Processing (NLP) and intelligent similarity-based ranking to improve the recruitment process. [1],[7],[12] efficiency of job seekers and employers alike. The suggested system will be a two-platform system with special modules for students/job seekers and for parents/guardians, employers. Job seekers can develop comprehensive profiles with information about their qualifications, technical skills, certifications and project experience, and Employers can publish the requirements for a job and browse for candidates. It uses NLP preprocessing techniques such as text normalization, tokenization, removal of stop words and skills. To extract, to convert profile and job description data from an unstructured to a meaningful representation. The system uses the TF- IDF inspired term weighting and weighted feature vectors to enhance the quality of the recommendations. Highlight the need for critical skills, certifications and qualifications. Candidate profiles and job descriptions are vectorized and cosine similarity is measured to determine the similarity between candidates and job descriptions. A semantic connection between their meaning. Furthermore, there is an exact skill matching boost system to incentivize skill matching at the key skill level, and This is followed by calculating a hybrid score based on both semantic similarity and skill overlap to give a recommendation score.[6],[7],[15] This method allows to rank jobs better for candidates and candidates better for the employers.

The system generates personalized job recommendations, identifies matched and missing skills, and provides transparent AI-based match scores to improve user trust and decision-making. Employers save the time of manual screening, as well as enjoy automated candidate ranking and shortlisting. recruitment time. The proposed solution is not only able to identify meaningful relationships among skills but also is different from traditional keyword-based approaches. It improves the accuracy of profile matching and better hiring outcomes due to profile attributes. The use of NLP pre-processing, TF-IDF weighting, cosine similarity, and cosine similarity clustering proves to be effective in experimental evaluation. hybrid scoring improves the accuracy of recommendations, while providing scalable support for today's recruitment environments. The proposed system helps in the efficient alignment of

candidate-job, which in turn helps in improving the process of intelligent talent acquisition. Recruitment quality, and helping to make data-driven hiring decisions.

Keywords: Artificial Intelligence, Job Recommendation System, candidate Recommendation, Natural Language Processing (Recruitment Automation), (Hybrid Recommendation System) (NLP), (TF-IDF)

1. INTRODUCTION

The rapidly expanding digital recruitment platforms and the growing demand for skilled professionals have led to the recent surge in recruitment job market. Overhauled the talent identification and recruitment process for organizations. While these developments have been made, the recruitment procedure still has a number of issues to resolve, such as the manual recruitment of resumes.[1],[14]. The pain points mentioned above – screening, poor candidate shortlisting, slow hiring processes and mismatching of candidate skills and requirements – are the sources of this. This comes from the following pain points screening, inefficient candidate shortlisting, extended hiring cycles and incorrect matching of candidate skills and requirements and job requirements. Typical recruiting systems are mainly keyword- or key phrase-driven and manually reviewed, which doesn't always result in successful outcomes. Properly capture the real importance of candidate profiles and job descriptions. Consequently, employers spend a lot of time sifting through the applications, and job seekers are unable to find jobs that are available. Thus, employers have to take a lot of time to consider applications, and job seekers have trouble finding jobs that are available. align with their skills, qualifications including career aspirations. To overcome these problems, the present research suggests an intelligent AI-based Job Recommendation and Candidate Matching System which employs intelligent similarity-based ranking techniques and Natural Language Processing (NLP) to enhance the efficiency and effectiveness of job recommendation and candidate matching. Effective recruitment processes for a high level of accuracy[1],[7],[12]. The system is designed to help two parties—job seekers and job seekers—using a common platform that automates the profile analysis, job and salary search process, and helps to connect them. Skill Based Matching, Candidate Ranking, Recommendation. The proposed solution offers the ability to utilize artificial intelligence techniques to minimize manual work, improve the quality of recruitment, and more. facilitates data-driven decision-making. the system offers special sections for the students/job seekers and employers[6],[7],[15]. Applicants can develop full profiles with qualifications, technical skills and certifications, as well as their project experience. Based on this information, the system generates personalized job recommendations ranked according to their relevance and compatibility with the user's profile. Employers can advertise job descriptions detailing the skills, qualifications and duties expected of the position [6],[7],[15]. The system then automatically processes the available candidate profile, and recommends suitable candidates for the provided job role. The proposed system's major feature is the use of NLP techniques and semantic based approach. similarity analysis. The data from the profile and job description are first preprocessed using the NLP operations, including normalization, tokenization, and lemmatization. the text data from the profile and job description are initially preprocessed using the NLP operations like text normalization, tokenization and lemmatization. stop-word removal. These processes transform unstructured textual data to structured data, appropriate for computational analysis. Weighted feature representation of important skills, qualifications, certifications and domain specific keywords are extracted. vectors. The system uses TF-IDF inspired term weighting to enhance the accuracy of their recommendations, giving the terms higher weights that have a higher relevance.

Emphasize the importance of unique and pertinent abilities and minimize the effect of general words. The candidate profiles are converted into weighted vector representations as are also the job descriptions. Then, the Cosine Similarity algorithm, a common method for calculating similarity between vectors, is used to calculate the similarity between these vectors. Measuring the similarity of semantic content of textual documents. The system also uses an Exact Skill Match Boosting mechanism that gives credit to the exact Skills that are essential to the game. To calculate the final recommendation score, a hybrid approach is used, comprising of semantic similarity, skill overlap and knowledge overlap. The relevance of qualifications, and the relevance of certification. As opposed to traditional recruitment

systems run on keyword matching, the proposed solution attempts to utilize the broader context of a text for recruitment. Applies understanding of the general context and relevance of candidate profiles and job specifications. For instance, if a student has Python, Machine Learning, SQL, and TensorFlow skills, he or she can be granted: Following these recommendations, the AI Engineer, Data Analyst, or Machine Learning Developer role is recommended for the following skills based on these recommendations, the following skills suggest a role of Artificial Intelligence Engineer, Data Analyst, or Machine Learning Developer: Similarity between their profile and job descriptions that are available. Likewise, employers who post a job with a requirement for Python, Cloud Computing, Data Analytics will get a ranked list of candidates with these skills. candidates who have the most similar profile to the required ones.[4],[10] The system is also making recommendations easier to understand by providing explainable AI-based recommendation scores. Detailed matching information is provided with recommended jobs and candidates, such as similarity percentages, matched skills, missing skills, qualification compatibility and recommendation confidence levels. This feature allows for both the job seeker and employer to get a sense of why the relevance of the generated recommendations. make informed decisions. Additionally, the proposed system is designed as a web application having an easy-to-use GUI that can be used: The following features include profile management, job posting, candidate search, visualization of candidate recommendations, and real-time analysis of matching. The architecture is scalable and can be expanded to accommodate sophisticated recruitment analytics, parsing of resumes, analysis of the skill gaps, and more. And adaptive recommendation strategies based on the changes in labor market, Combining NLP preprocessing, TF-IDF based weightage and cosine similarity, exact skill matching and hybrid recommendation approach.[2],[3],[8],[13] In the present era, the suggested AI-Based Job Recommendation System offers a smart and effective approach to the job recommendation system. recruitment challenges.

The system will greatly cut down the amount of manpower required in the recruitment process, increase the accuracy of matching, boost user satisfaction and enhance the user experience. Helps job seekers and employers faster and better hire decisions.

2. LITERATURE SURVEY

The decade has witnessed the transformation of recruitment and job recommendation systems significantly, as they have become intelligent even with the incorporation of Artificial Intelligence (AI), Natural Language Processing (NLP), and recommendation technologies[6],[7]. Traditional recruitment methods typically involved human resume screening and keyword matching methods, which were time-consuming and prone to errors. The conventional recruitment methods were mainly based on manual resume screening and keyword matching, which were time-consuming and prone to errors. Recruit appropriate personnel for a job opening. Although simple to implement, these systems frequently produced inaccurate recommendations because they depended on exact keyword matches and were unable to understand contextual relationships between candidate skills and job requirements. Early job recommendation systems employed basic text matching algorithms that compared keywords present in resumes with those specified in job descriptions. While such approaches improved recruitment automation, they often failed to recognize semantic similarities between related terms. For instance, terms such as “Python Programming,” “Python Development,” and “Python Scripting” may represent similar competencies but were frequently treated as unrelated keywords by conventional systems. This limitation resulted in missed opportunities for both employers and job seekers. To overcome these challenges, researchers introduced Natural Language Processing (NLP) techniques for extracting meaningful information from unstructured textual data. Text preprocessing methods such as tokenization, stop-word removal, stemming, and lemmatization significantly improved the quality of extracted features[1],[7],[12]. Subsequently, Term Frequency–Inverse Document Frequency (TF-IDF) emerged as a popular technique for assigning importance weights to words and skills within resumes and job descriptions. By emphasizing distinctive skills and reducing the influence of common terms, TF-IDF improved the accuracy of profile matching and candidate ranking[6][7][15]. Another major advancement in recruitment technology involved the adoption of similarity-based

recommendation techniques. Cosine Similarity became one of the most widely used methods for measuring the semantic closeness between candidate profiles and job descriptions represented as numerical vectors[2],[8].

Several studies demonstrated that cosine similarity effectively ranks candidates according to their relevance to job requirements while maintaining computational efficiency, making it suitable for real-time recommendation systems. Researchers also explored collaborative filtering techniques to generate recommendations based on user interactions and historical hiring patterns[2],[3],[13]. Although collaborative filtering achieved success in domains such as e-commerce and entertainment, its application in recruitment systems was limited by the cold-start problem, where insufficient user interaction data reduced recommendation accuracy for new candidates and newly posted jobs. Content-based recommendation approaches addressed some of these limitations by focusing directly on candidate skills, qualifications, and job requirements. However, such systems often generated highly specialized recommendations and lacked flexibility when dealing with diverse career paths and transferable skills. Recent developments in Artificial Intelligence have introduced advanced deep learning models such as Word2Vec, Fast Text, BERT, and Transformer-based architectures for semantic skill matching and resume analysis[5],[10]. These approaches provide a deeper understanding of contextual relationships between words and can capture complex semantic patterns in job descriptions and candidate profiles. While these models significantly improve matching accuracy, they typically require large-scale datasets, extensive training resources, and substantial computational power, making them challenging to deploy in lightweight recruitment systems and academic prototype implementations. The proposed AI-Based Job Recommendation System builds upon the strengths of existing research while maintaining computational efficiency and practical applicability. The system utilizes NLP preprocessing techniques, stop-word removal, TF-IDF-inspired term weighting, cosine similarity, and exact skill matching to generate accurate recommendations for both job seekers and employers. Candidate profiles and job descriptions are transformed into weighted feature vectors, enabling semantic comparison and intelligent ranking. In addition, a hybrid recommendation mechanism combines semantic similarity with direct skill overlap, qualification matching, and certification relevance to improve recommendation quality. This approach achieves a balance between recommendation accuracy, interpretability, and computational efficiency, making it suitable for modern web-based recruitment environments[5],[9],[10].

S.No	Title of the Paper	Author(s) and Publication Details	Limitations
1	Finding a Perfect Match: Recruitment using AI	Sundaresan, N., & Kinsella, S., ACM SIGKDD, 2015	Relies on static keyword matching, leading to poor contextual understanding of skills.
2	Skill Extraction Using NLP for Recruitment Systems	Zhang, Q., & Cheng, W. Journal of NLP Applications, 2019	Limited contextual understanding due to reliance on word frequency; lacks integration of recommendation techniques.
3	Challenges in Job Matching: A Review of Recruitment Technologies	Brown, T., & Lee, Y. International Journal of Human Resource Management, 2020	No mechanism to address ambiguity in skill definitions or automate standardization.

4	Recommender Systems in Recruitment: A Survey	Ricci, F., Rokach, L., & Shapira, B., Springer Handbook on Recommender Systems, 2011	Collaborative filtering suffers from cold-start problems; content-based filtering struggles with adaptability.
5	Deep Learning for Contextual Job Recommendations	Li, X., & Han, S., Neural Networks Journal, 2021	Requires extensive datasets for training; computationally expensive for small-scale systems.
6	Advances in Natural Language Processing	Hirschberg, J., & Manning, C. D., Science, 2015	High computational cost for complex NLP tasks; unsuitable for real-time applications in recruitment.

3. PROBLEM STATEMENT

Modern recruitment platforms frequently suffer from inaccurate job-candidate matching, excessive manual screening efforts, prolonged hiring cycles, and limited transparency in recommendation results. Traditional systems primarily depend on keyword matching techniques, which fail to capture the semantic relevance between candidate profiles and job requirements[6],[7], [15]. As a result, qualified candidates may be overlooked despite possessing relevant skills expressed using different terminology. Job seekers often face difficulties identifying opportunities that align with their qualifications, certifications, technical competencies, and career interests. Similarly, employers spend significant time reviewing applications and shortlisting candidates due to the absence of intelligent candidate ranking mechanisms. Existing recruitment platforms also provide limited feedback regarding profile strengths, skill gaps, and recommendation rationale. Therefore, there is a need for an AI-based recruitment solution capable of analyzing profile information, extracting relevant skills, computing semantic similarity, and generating explainable recommendations for both job seekers and employers. The approach to solve these challenges in the proposed system is based on NLP preprocessing, TF-IDF based weighting, cosine similarity, mixed methods of the recommendation scoring[1],[2],[3].

4. OBJECTIVE

The approach to solve these challenges in the proposed system is based on NLP preprocessing, TF-IDF based weighting, cosine similarity, mixed methods of the recommendation scoring.

1. Intelligent Job Recommendation

Automatically generate job recommendations for students and job seekers according to their personal pictures Qualifications, skills, certifications and project experience.

2. Candidate Recommendation for Employers

Allow employers to discover and prioritize appropriate candidates for employment based on their job. Reduce manual screening effort, due to requirements.

3. NLP Based Profile Analysis

Use the NLP preprocessing technique of text normalization, tokenization, stop-word removal, etc. Extracting data from profile and job descriptions and skills[1],[7],[12].

4. TF-IDF Based Skill Weighting

Give weights to technical skills and qualifications using the TF-IDF inspired vector approach representations[6],[7],[15].

5. Semantic Similarity Matching

Use cosine similarity to determine the relevance between candidate profile and the job postings descriptions[6],[7],[15].

6. Hybrid Recommendation Scoring

Integrate skill match, relevance of qualifications, certification and semantic similarity Matching to enhance the accuracy of the recommendations[2], [3],[8],[13].

7. Explainable AI Recommendations

Give transparent match scores, matched skills, missing skills and provide recommendation Advances to provide helpful information for decision making[9],[14].

8. Recruitment Automation

Automate candidate ranking and job recommendations to improve the quality of the hire and save time recruitment.

5. IMPLEMENTATION

The proposed AI Based Job Recommendation System is developed in the form of Web Based Application with the following technologies: HTML, CSS and JavaScript. It has dedicated interfaces for the students and the employers and also has a recommendation based on NLP. strategies to increase the efficiency of recruitment. It combines Natural Language Processing (NLP), TF-IDF-based feature weighting, cosine similarity, and hybrid scoring techniques to generate accurate and explainable recommendations[1],[7], [15].

A. Data Collection and Profile Creation

Job seekers create profiles by entering information such as qualification, technical skills, certifications, and project experience. Employers provide job details including the company name, job role, required skills, and job description[6].

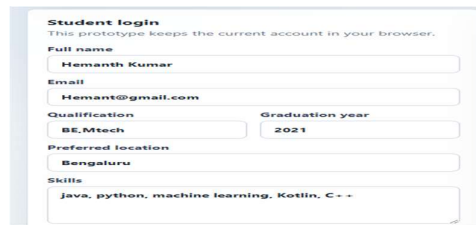


Fig :Candidate Profile Creation

These inputs are stored in a structured format and processed by the recommendation engine.

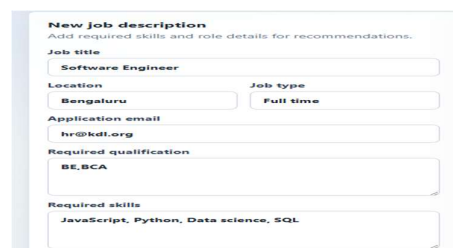


Fig : Employer Job description

B. NLP Preprocessing

The first stage of implementation involves preprocessing the textual data. This step converts unstructured profile and job information into a standardized form suitable for analysis[7].

The preprocessing operations include:

- Converting text to lowercase
- Removing punctuation and special characters
- Tokenizing the text into individual words
- Removing common stop-words such as “and”, “the”, “for”, and “with”.

Original Text:	“Python, Machine Learning, and SQL”
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After Preprocessing:
Python

<i>Machine</i>
<i>Learning</i>
<i>Sql</i>

This normalization process ensures that different writing styles are treated consistently[15].

C. TF-IDF-Based Feature Weighting

After preprocessing, the system assigns weights to extracted terms using a TF-IDF-inspired weighting mechanism[6],[7],[15]. Important and distinctive skills receive higher weights than commonly occurring words.

The TF-IDF score is calculated as:

$$TF-IDF(t,d)=TF(t,d)*IDF(t)$$

Where:

$TF(t,d)$ =Frequency of term t in document d

$IDF(t)$ =Importance of term t across all documents

<i>Skill</i>	<i>Weight</i>
<i>Python</i>	<i>0.45</i>
<i>SQL</i>	<i>0.38</i>
<i>TensorFlow</i>	<i>0.82</i>

In this example, TensorFlow are converted into numerical vectors so that mathematical comparisons can be performed.

D. Vector Representation

The weighted skills are converted into numerical vectors so that mathematical comparisons can be performed[2],[8].

Example:

<i>Skill</i>	<i>TF-IDF Weight</i>
<i>Python</i>	0.45
<i>SQL</i>	0.38
<i>Machine Learning</i>	0.71

The student profile is represented as a weighted vector, and the same process is applied to the job description.

E. Cosine Similarity Calculation

The similarity between a candidate profile and a job description is measured using cosine similarity[3],[13]. This method determines how closely the two vectors align.

Where:

A = Candidate profile vector

B = Job description vector

$A \cdot B$ = Dot product of the vectors

$|A|$ and $|B|$ = Magnitudes of the vectors

<i>Matched Skill</i>	<i>Value</i>
<i>Python</i>	Yes
<i>SQL</i>	Yes
<i>TensorFlow</i>	No

If the computed cosine similarity is 0.87, the semantic compatibility score becomes 87%.

F. Exact Skill Match Boosting

To improve recommendation accuracy, the system provides an additional boost when critical skills exactly match between the candidate profile and the job requirements[4].

<i>Candidate Skills:</i>	<i>Python, SQL, Machine Learning</i>
<i>Job Skills:</i>	<i>Python, SQL, TensorFlow</i>

S

Exact Matches:

✓ **Python**

✓ **SQL**

These exact matches increase the final recommendation score and help prioritize highly relevant candidates.

G. Hybrid Recommendation Scoring

The final score combines multiple factors rather than relying on a single similarity value.

The hybrid score is computed as:

$$\text{Final Score} = (0.52 * \text{Semantic Similarity})$$

Component	Score
Semantic Similarity	87%
Skill Match	90%
Qualification Match	100%
Certification Match	75%

✓ **Final AI Match Score - 92%**

H. Recommendation Generation

After computing the hybrid score, the system ranks the results in descending order[5].

Recommended Job:

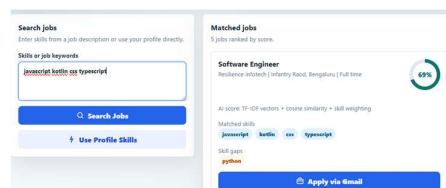


Fig : Recommended jobs

Recommended Candidate:



Fig : Recommended Candidates

The system also displays matched skills, missing skills, qualification compatibility[10], and confidence scores, making the recommendations transparent and easy to interpret.

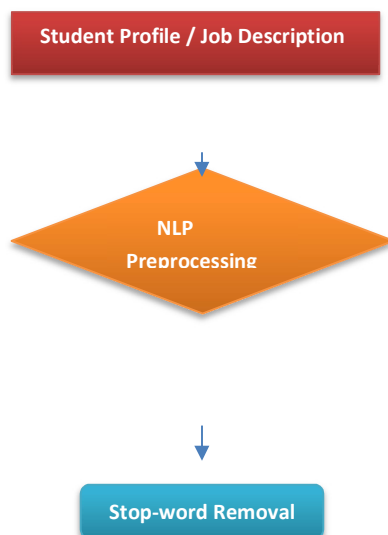
I. Web-Based User Interface

The implementation is integrated into a responsive web interface that allows users to:

- Create accounts
- Manage profiles
- Post job requirements
- Search Candidates
- View AI-based recommendations
- Analysis match scores in real time

This user-friendly interface ensures that both job seekers and employers can interact with the recommendation engine without requiring technical expertise.

6. SYSTEM ARCHITECTURE



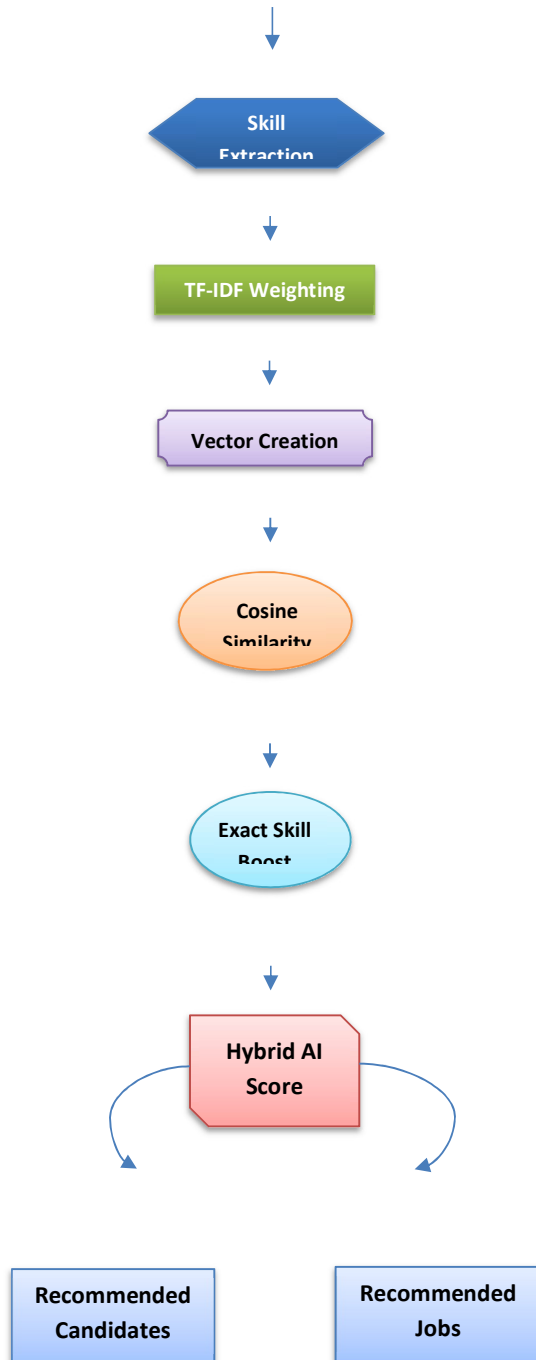


Fig 1 : System Architecture[14].

Mathematical Model Section

Cosine Similarity Formula

$$\text{Cos}(\theta) = (\mathbf{A} \cdot \mathbf{B}) / (|\mathbf{A}| |\mathbf{B}|)$$

Where:

A = Candidate Vector

B = Job Vector

$A \cdot B$ = Dot Product

$|A|$ = Magnitude of Candidate Vector

$|B|$ = Magnitude of Job Vector

7. RESULT GENERATION

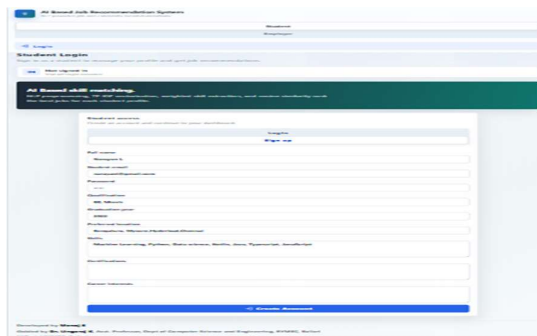


Fig 1: Create Candidate Account

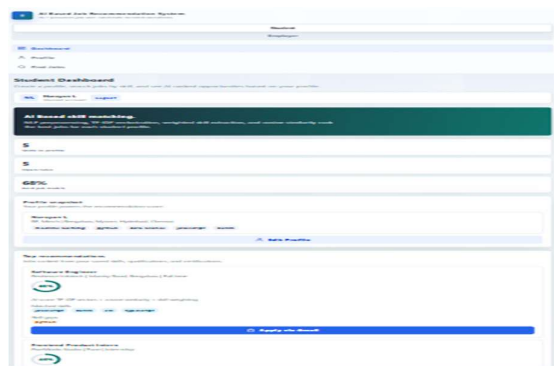


Fig 2: Candidate Dashboard

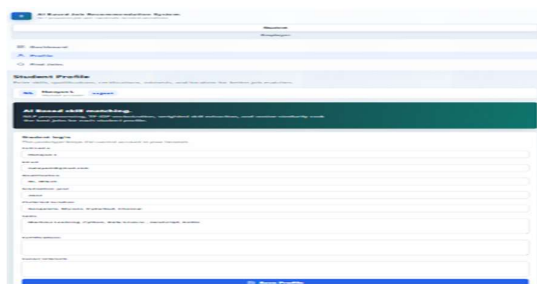


Fig 3: Candidate Profile

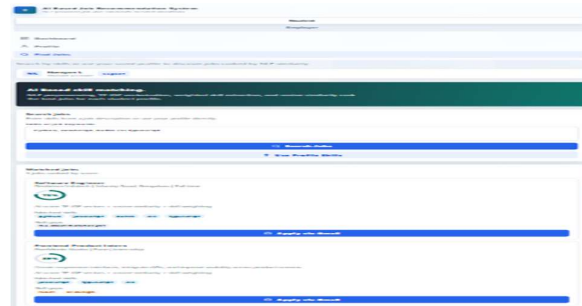


Fig 4: Student/candidate Find Jobs

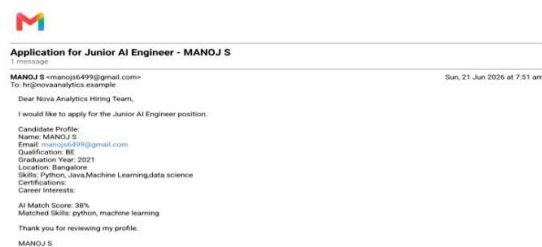
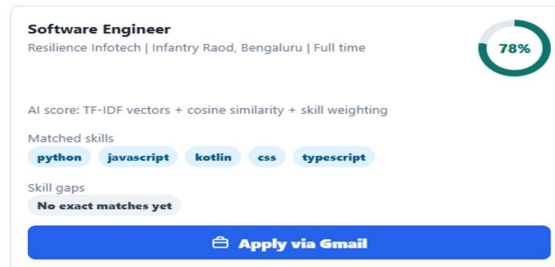


Fig 5 and 6: Student/candidate Apply via Gmail

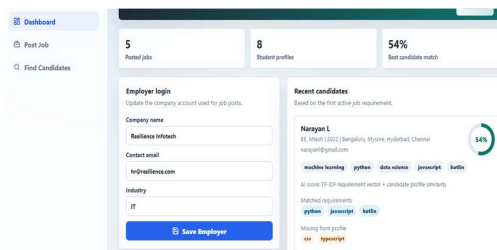


Fig 7: Employer Dashboard

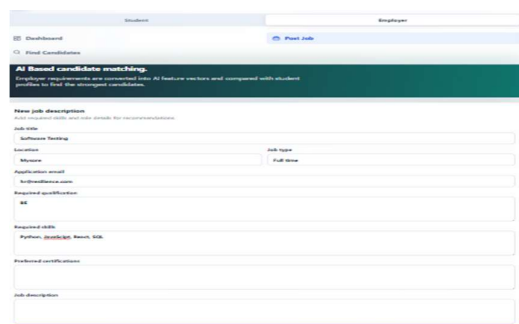


Fig 8: Employer Job Post

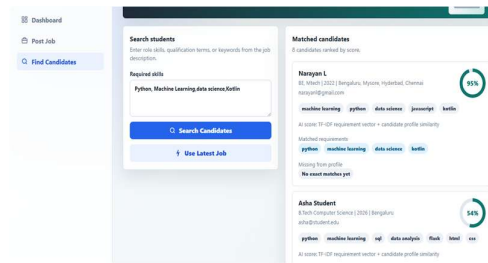


Fig 9: Employer **Find Candidates**

8. CONCLUSION

The proposed AI-Based Job Recommendation System provides an intelligent recruitment solution that improves candidate-job matching through Natural Language Processing and similarity-based recommendation techniques[1]-[15]. By integrating NLP preprocessing, TF-IDF-based weighting, cosine similarity, exact skill matching, and hybrid recommendation scoring, the system generates accurate and explainable recommendations for both job seekers and employers. The web-based platform automates profile analysis, candidate ranking, and job recommendation processes, reducing manual effort and improving recruitment efficiency[2],[3],[6],[13],[14]. The proposed approach demonstrates how AI techniques can enhance modern talent acquisition systems and support data-driven hiring decisions.

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