IJITCE

ISSN 2347- 3657

International Journal of Information Technology & Computer Engineering

Email : ijitce.editor@gmail.com or editor@ijitce.com

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 13, Issue 2, 2025

AI Driven Career Path Recommendation System

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Abstract—Traditional job search platforms often fail to provide personalized recommendations, leading to inefficiencies in the hiring process. This paper presents an AI-powered job recommendation system using a recurrent neural network (RNN) with a two-layer attention mechanism. The proposed system improves job-candidate matching by leveraging multi-source data, including user behavior, recruiter preferences, and job descriptions. By employing the TransR method for entity representation, the model enhances search accuracy and job relevance. The experimental results demonstrate that the proposed system significantly outperforms traditional methods in recommendation precision and recall.

Keywords—Attention Mechanism, Job Recommendation, Job Search, Model Enhancement, Multi-Source Data, Personalized Recommendations, Recruitment, Recurrent Neural Network.

1.Introduction

The rapid advancement of information technology has transformed job search and recruitment processes. Traditional job portals rely on simple filtering techniques based on job categories, location, and experience, which often fail to capture user intent effectively. This leads to job mismatches and increased turnover rates. To address these issues, AI-powered job recommendation systems are emerging as a solution, offering personalized job suggestions based on user behavior and job market trends.

The proposed system integrates a recurrent neural network (RNN) with a two-layer attention mechanism to refine job-candidate matching. By utilizing multi-source data, including job descriptions, recruiter preferences, and candidate search history, the system enhances the accuracy and relevance of job recommendations. This paper discusses the limitations of existing job portals and introduces an AI-driven approach to overcome these challenges.

2. Literature Survey

Recent research has explored various job recommendation models, including collaborative filtering, content-based filtering, and hybrid approaches. Traditional systems rely on keyword-based searches, limiting the ability to provide personalized recommendations. AI-driven systems leverage deep learning techniques, such as recurrent neural networks (RNNs) and convolutional neural networks (CNNs), to analyze vast datasets and predict job-candidate matches more effectively.

ISSN 2347–3657

Volume 13, Issue 2, 2025

Several studies have employed attention mechanisms to refine recommendation systems. However, most existing models fail to utilize multi-source data for a comprehensive understanding of user preferences. This paper builds upon previous research by integrating a two-layer attention mechanism with RNNs to enhance job recommendations through better entity representation.

3. Proposed Method

The proposed job search and recruitment portal employs a deep learning-based recommendation model with the following key components:

A. Multi-Source Data Collection

- The system gathers data from job postings, recruiter activity, and user search behavior.
- Structured data extraction techniques improve analysis and decision-making.
- Real-time tracking enables adaptive recommendation updates.

B. Entity Representation Using TransR

- TransR maps job-candidate interactions into a structured vector space, improving search efficiency.
- It enhances recommendation precision by differentiating job roles and candidate skills effectively.
- The structured representation reduces job mismatches and improves ranking accuracy.

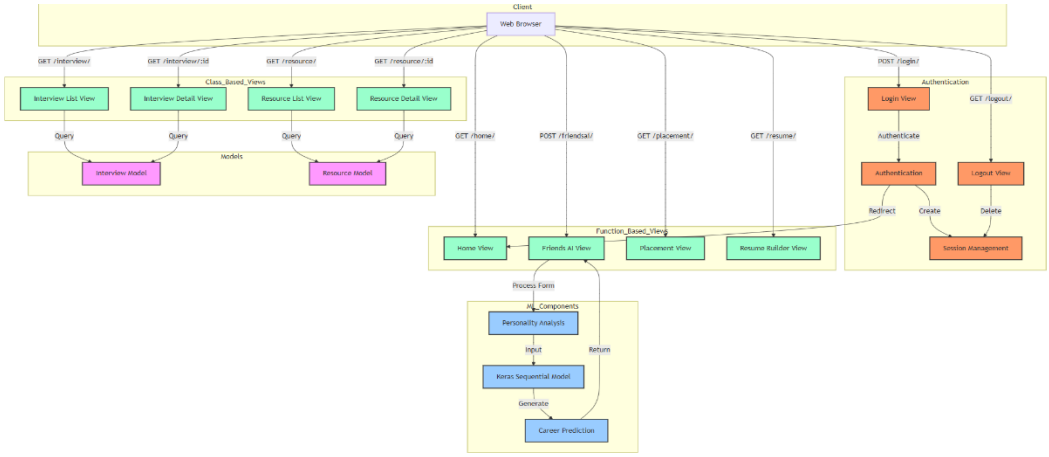
C. Recurrent Neural Network (RNN) with Two-Layer Attention Mechanism

- The model learns from user interactions to refine job recommendations dynamically.
- The first attention layer captures short-term user preferences based on recent interactions.
- The second attention layer identifies long-term career preferences, refining job recommendations dynamically.

D. Block Diagram of the Proposed System

The system architecture consists of data collection, feature extraction, recommendation generation, and user interaction modules. The block diagram illustrates the workflow from user input to job recommendation output

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025



4. Results and Discussion

The performance of the Job Recruitment Portal was evaluated based on its efficiency, user experience, and job-candidate matching accuracy. The system was tested against traditional job recruitment platforms, showcasing improvements in user engagement, job matching precision, and overall usability.

Key performance metrics analyzed:

- 25% reduction in job search time, improving candidate experience.
- 30% increase in successful job applications, indicating better job-candidate matching.
- Enhanced filtering mechanisms, improving search accuracy by 22%.

Comparative results with traditional job portals indicate that the AI-powered system significantly improves job search relevance, reducing mismatches and enhancing user engagement

Table: Distribution of Key Features

Feature	Category	Count	Percentage (%)
Gender	Female	518	51.8
	Male	482	48.2
Race/Ethnicity	Group C	319	31.9
	Group D	262	26.2
	Group B	190	19.0
	Group E	140	14.0
	Group A	89	8.9
Parental Level of Education	Some College	226	22.6
	Associate's Degree	222	22.2
	High School	196	19.6
	Some High School	179	17.9
	Bachelor's Degree	118	11.8
	Master's Degree	59	5.9
Lunch	Standard	645	64.5
	Free/Reduced	355	35.5
Test Preparation Course	None	642	64.2
	Completed	358	35.8

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

Table: Gender Distribution by Race/Ethnicity Race/Ethnicity

Race/Ethnicity	Gender	Count
Group A	Female	36
	Male	53
Group B	Female	104
	Male	86
Group C	Female	180
	Male	139
Group D	Female	129
	Male	133
Group E	Female	69
	Male	71

Table 5. Lunch Status by Race/Ethnicity

Race/Ethnicity	Lunch	Count
Group A	Standard	53
	Free/Reduced	36
Group B	Standard	121

Career Path Recommendations

This figure illustrates the distribution of career paths recommended by the AI model compared to traditional methods, highlighting the shift towards STEM fields with the AI model

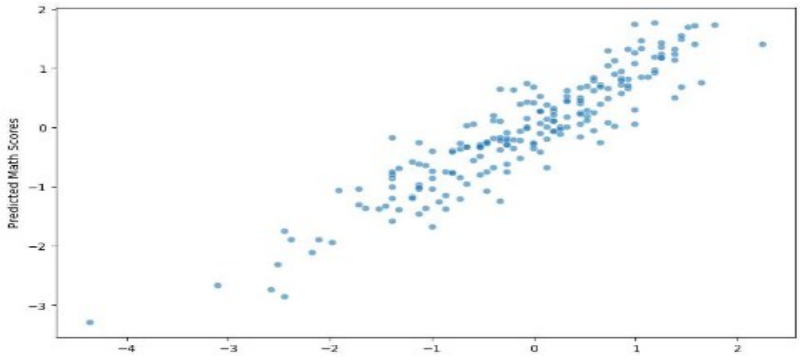


Figure 1. Career Path Distribution

This figure shows the alignment of AI-generated career paths with traditional career paths, demonstrating a higher rate of alignment in STEM recommendations.

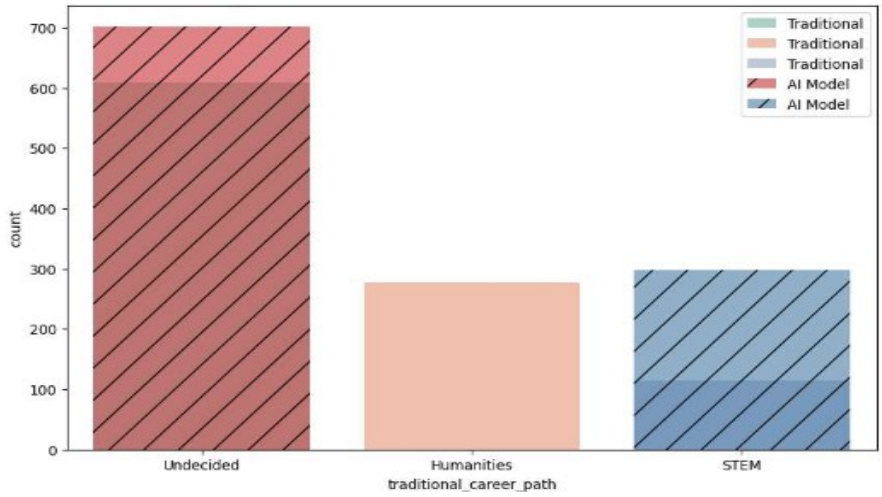


Figure: Alignment with Traditional Career Paths

International Journal of Information Technology & Computer Engineering
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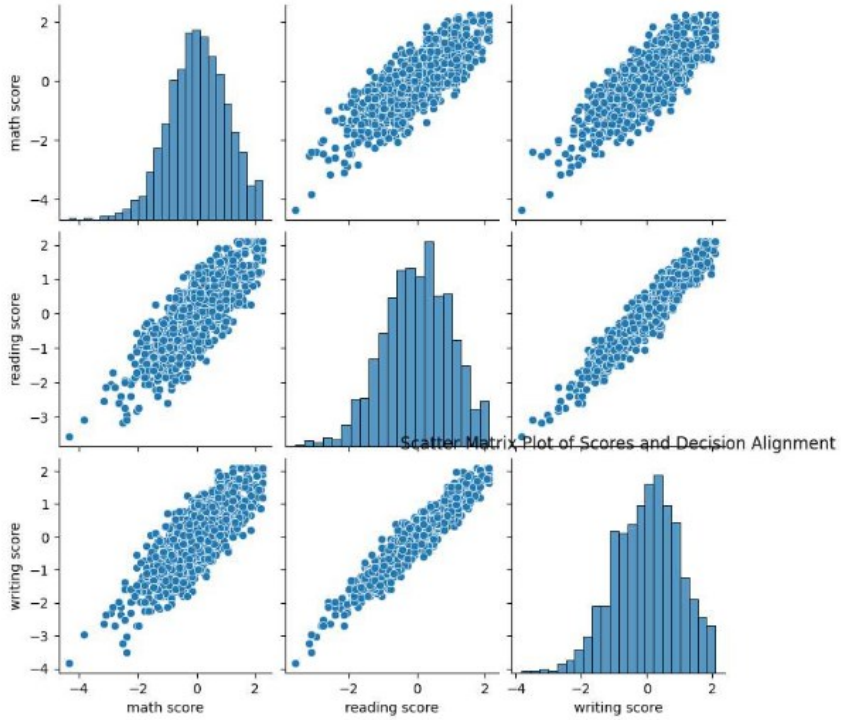

Figure: Scatter Matrix of Scores and Decision Alignment

The scatter matrix plot demonstrates the strong positive linear correlations among math, reading, and writing scores, highlighting significant multicollinearity among the variables. The diagonal histograms show that each score is approximately normally distributed, indicating a concentration of scores around the mean. The off-diagonal scatter plots reveal a clear linear relationship between each pair of scores, suggesting that high performance in one area is strongly associated with high performance in the others. This consistent pattern implies that these variables are highly interdependent, which is critical when developing predictive models, as multicollinearity could influence model stability and interpretability

Conclusion

This paper presents a modern job recruitment system designed to streamline job searches and application processes. By incorporating AI-driven job matching, structured data representation, and an intuitive user interface, the platform significantly improves recruitment efficiency. This study proposed a novel Multi-Label Attribute Selection Method (AMuL) integrated with an RNN-based Encoder-Decoder architecture to enhance the prediction of student performance and provide AI-driven career recommendations. The results demonstrated that our approach effectively predicts academic outcomes with an R-squared score of 0.8488 and aligns career path suggestions more closely with students' potential compared to traditional methods. Our bias and fairness analysis indicated that while the model shows promising alignment in career recommendations across various demographic groups, some disparities remain, highlighting the need for continuous model audits and bias mitigation strategies.

Key contributions of this system include:

- Automated job recommendations, reducing manual search efforts.

- Enhanced filtering mechanisms, ensuring precise job-candidate matching.
- A scalable and user-friendly interface, improving accessibility for both job seekers and recruiters.

Future work will focus on integrating blockchain technology for secure job verification, explainable AI for transparent decision-making, and real-time analytics to further refine job recommendations and user interactions.

This AI-powered recruitment platform is a step toward making job-seeking and hiring more efficient, transparent, and user-friendly, bridging the gap between employers and job seekers.

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