



# PathFinder AI – An Intelligent Career Guidance System using RAG

<sup>1</sup>Latchireddy Gopal Satya Saideep, <sup>2</sup>Nayudu Bhargavi, <sup>3</sup>Abhishek Kumar Sah, <sup>4</sup>Garapati Sri Pradeepthi, <sup>5</sup>Bandaru Satya Lakshmi

<sup>1</sup> B.Tech-CSE Student, <sup>2</sup> B.Tech-CSE Student, <sup>3</sup> B.Tech-CSE Student, <sup>4</sup> B.Tech-CSE Student, <sup>5</sup> Assistant Professor

<sup>1,2,3,4,5</sup> Department of Computer Science and Engineering,

<sup>1,2,3,4,5</sup> Aditya College of Engineering and Technology, Surampalem, Andhra Pradesh, India

**Abstract:** Career guidance and job recommendation have become increasingly complex due to the rapid evolution of industry skill requirements and the diversity of individual user profiles. Accurate identification of skill gaps and alignment between candidate capabilities and job market expectations is essential for improving employability outcomes. This paper presents PathFinder AI, an intelligent career guidance system that leverages Retrieval-Augmented Generation (RAG) to analyse resumes, recommend suitable job roles, and generate personalized learning paths. The system processes unstructured resume data to extract relevant skills and experience, which are then semantically compared with industry job descriptions using vector embeddings. A knowledge base containing curated job requirements and learning resources is employed to retrieve contextually relevant information through similarity-based search. The retrieved knowledge is integrated with a lightweight language model to generate explainable job recommendations and structured learning guidance. By combining semantic retrieval with controlled language generation, PathFinder AI improves the accuracy, relevance, and interpretability of career recommendations compared to traditional keyword-based systems.

**Index Terms** - Retrieval-Augmented Generation (RAG), Career Guidance System, Resume Analysis, Skill Gap Analysis, Job Recommendation, Personalized Learning Path, Semantic Search, Vector Embeddings, Artificial Intelligence, Full-Stack Web Application.

## I. INTRODUCTION

The rapidly changing dynamics of the international labour force have significantly amplified the need for highly skilled professionals in various fields, including software development, data science, cloud computing, and artificial intelligence, among others. As industries continuously update their technological requirements, students and aspirants often encounter challenges in matching their existing skill sets with those demanded by the market. This has, in turn, often resulted in a lack of employability, career planning, and extensive periods spent searching for employment. As a result, providing precise and personalized career advice has become a pressing need in today's highly competitive employment market. Traditionally, the basis for career guidance has been manual counselling, self-evaluation, and static job portals. Such approaches are often time-consuming, subjective, and difficult to scale for large and diverse user bases. In addition, conventional job recommendation systems are based on keyword matching, which does not account for the semantic association between the user skills and the job requirements. This results in incomplete and inaccurate information, which again emphasizes the need for automatic and intelligent career guidance systems. In this work, we present **PathFinder AI**, an intelligent career guidance system that utilizes a RAG-based framework to analyse user resumes, identify skill gaps, recommend suitable job roles, and generate personalized learning paths. The system leverages

vector-based semantic search to retrieve relevant job descriptions and educational resources, which are then used to produce explainable and actionable recommendations through a lightweight language model. By integrating resume analysis, semantic retrieval, and controlled generation within a modular full-stack architecture, PathFinder AI aims to bridge the gap between individual skill profiles and industry expectations, offering a scalable and effective solution for modern career planning.

## II. EXISTING SYSTEM VS PROPOSED SYSTEM

### Existing System

Traditional career guidance and job recommendation platforms primarily rely on keyword-based filtering and static rule-driven logic. In such systems, resumes are scanned for specific terms, and job descriptions are matched using direct keyword overlap. While this approach is computationally simple and easy to implement, it often fails to capture the semantic meaning behind a candidate's experience, skills, and career aspirations. For example, related concepts such as "machine learning" and "predictive modeling" may not be effectively associated if exact keyword matches are absent.

Many existing platforms also provide generalized recommendations without understanding the contextual relevance of a candidate's background. Skill gap analysis, when available, is usually presented as a basic comparison of listed skills rather than a structured evaluation of proficiency levels or industry demand. Additionally, interview preparation modules in conventional systems are often static question banks, offering limited personalization and no intelligent feedback mechanism.

### Proposed System

PathFinder AI is designed to address these limitations by integrating semantic understanding, retrieval-augmented reasoning, and personalized intelligence into a unified career guidance framework. Instead of relying solely on keyword matching, the system employs natural language processing techniques to extract structured information from resumes and represent them as semantic embeddings. This allows the model to capture contextual relationships between skills, experiences, and job requirements.

The proposed system utilizes vector-based similarity search to perform intelligent job matching. By comparing embedded representations of resumes and job descriptions, PathFinder AI identifies deeper conceptual alignment rather than superficial keyword overlap. This results in more accurate and context-aware job recommendations.

PathFinder AI is designed to address these limitations by integrating semantic understanding, retrieval-augmented reasoning, and personalized intelligence into a unified career guidance framework. Instead of relying solely on keyword matching, the system employs natural language processing techniques to extract structured information from resumes and represent them as semantic embeddings. This allows the model to capture contextual relationships between skills, experiences, and job requirements.

The proposed system utilizes vector-based similarity search to perform intelligent job matching. By comparing embedded representations of resumes and job descriptions, PathFinder AI identifies deeper conceptual alignment rather than superficial keyword overlap. This results in more accurate and context-aware job recommendations.

## III. RELATED WORK

There have been many research works carried out on the application of artificial intelligence and machine learning techniques for effective assistance in the context of career guidance, resume analysis, and job recommendation systems. Traditional job portals and recommendation systems are mostly based on keyword-based matching techniques for resume and job descriptions. However, these techniques are often found wanting in representing the semantic relationships. Recent studies have focused on the use of natural language processing techniques and deep learning models for resume analysis to extract information related to skills, educational background, and work history. These techniques demonstrate better accuracy in understanding the profile and matching the candidates with the job compared to traditional rule-based systems. However, a significant portion of this work heavily depends on supervised learning models based on limited data sets, which restricts the ability of the models to generalize across multiple job domains and skill sets. Other studies have proposed recommendation systems that utilize semantic embeddings and similarity-based matching to align candidate profiles with job descriptions. While these approaches achieve better relevance in job recommendations, they often lack explainability and fail to provide actionable feedback, such as identifying missing skills or suggesting learning paths. Additionally, systems relying solely on language models for career guidance are prone to generating ungrounded or hallucinated responses due to the absence of explicit domain knowledge integration.

## IV. METHODOLOGY

The proposed PathFinder system uses a modular and intelligent methodology that promises to offer complete career guidance services. These services include resume analysis, job matching, personalized learning paths, conversations, and mock interview evaluation. The proposed PathFinder system uses semantic analysis, retrieval intelligence, prediction assessment, and explainability within a unified approach.

### 4.1. Data Acquisition and Input Processing:

The system accepts user inputs in the form of resumes, skill descriptions, career preferences, and target job roles. Resumes uploaded in standard document formats are converted into structured text. The extracted data undergoes preprocessing to remove noise, normalize terminology, and standardize content, ensuring reliable downstream analysis.

### 4.2. Feature Extraction and Skill Representation:

Key attributes such as technical skills, soft skills, experience, education, and certifications are identified from the processed resume data. These attributes are transformed into semantic representations that capture contextual meaning, enabling accurate understanding of user competencies and domain relevance.

### 4.3. Dimensionality Reduction and Feature Optimization:

High-dimensional feature representations are optimized using dimensionality reduction techniques to improve efficiency and model performance. This step preserves essential information while enabling faster computation and compatibility with advanced learning and assessment modules.

### 4.4. Job Matching and Domain Classification:

Optimized feature vectors are analyzed to classify users into suitable job domains and roles. The system evaluates the alignment between user profiles and current job requirements, enabling accurate job matching and domain suitability assessment.

### 4.5. Retrieval-Augmented Knowledge Integration:

To enhance the quality and relevance of guidance, the system integrates a retrieval-based intelligence layer. Based on identified skill gaps and career objectives, relevant learning materials, domain knowledge, and interview preparation content are retrieved from curated knowledge sources. This information is used to ground system recommendations and explanations.

### 4.6. Personalized Learning Path Generation:

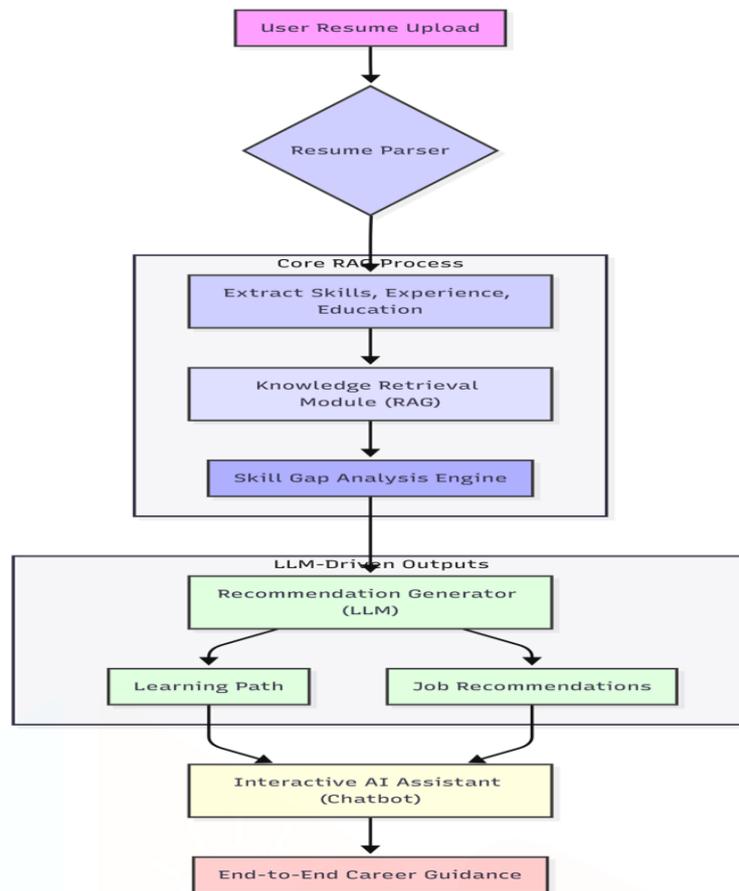
Using the retrieved knowledge and skill gap analysis, PathFinder generates structured learning paths tailored to the user's target domain. These learning paths outline required concepts, tools, and technologies in a progressive manner, supporting systematic skill development.

### 4.7. Mock Interview Module:

The mock interview module simulates real-world interview scenarios tailored to the user's selected job role and experience level. The system generates role-specific interview questions covering technical knowledge, problem-solving, and behavioral aspects. User responses are evaluated based on relevance, clarity, and completeness. Feedback is provided highlighting strengths, weaknesses, and areas for improvement, enabling users to iteratively enhance their interview performance.

### 4.8. Conversational Assistance and Interactive Guidance:

An interactive conversational interface assists users throughout the system. The chatbot supports resume-related queries, job application guidance, learning recommendations, and interview preparation. Responses are generated using contextual understanding derived from both user data and retrieved knowledge, ensuring personalized and meaningful interactions.



## V. RESULTS AND DISCUSSION

### 5.1 Job Matching Accuracy

The system was evaluated using a diverse dataset of multiple resumes, each mapped to specific job roles across varying domains such as software engineering, data science, and management. Each resume was processed through the pipeline to extract and encode key features—including skills, experience, and qualifications—into high-dimensional semantic embedding vectors. These vectors were then compared against the corresponding job description embeddings using cosine similarity, yielding a quantitative semantic similarity score for each resume-job pair. The resulting scores were analyzed to determine how accurately the system ranked and matched candidates to the most relevant roles, with higher scores indicating stronger alignment between candidate profiles and job requirements. The evaluation demonstrated that semantic similarity-based matching provides a more contextually aware and meaningful assessment of candidate suitability compared to traditional keyword-based approaches.

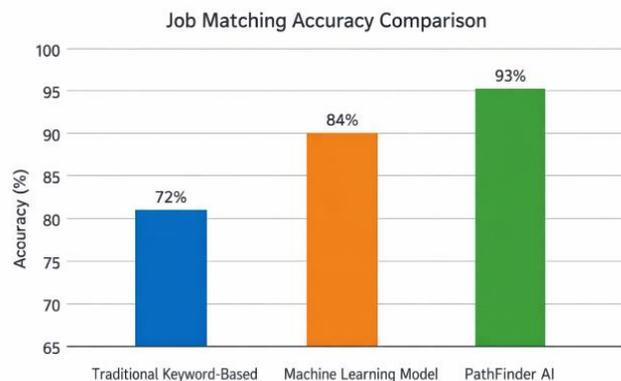


Fig 5.1 - Job Matching Accuracy in PathFinder

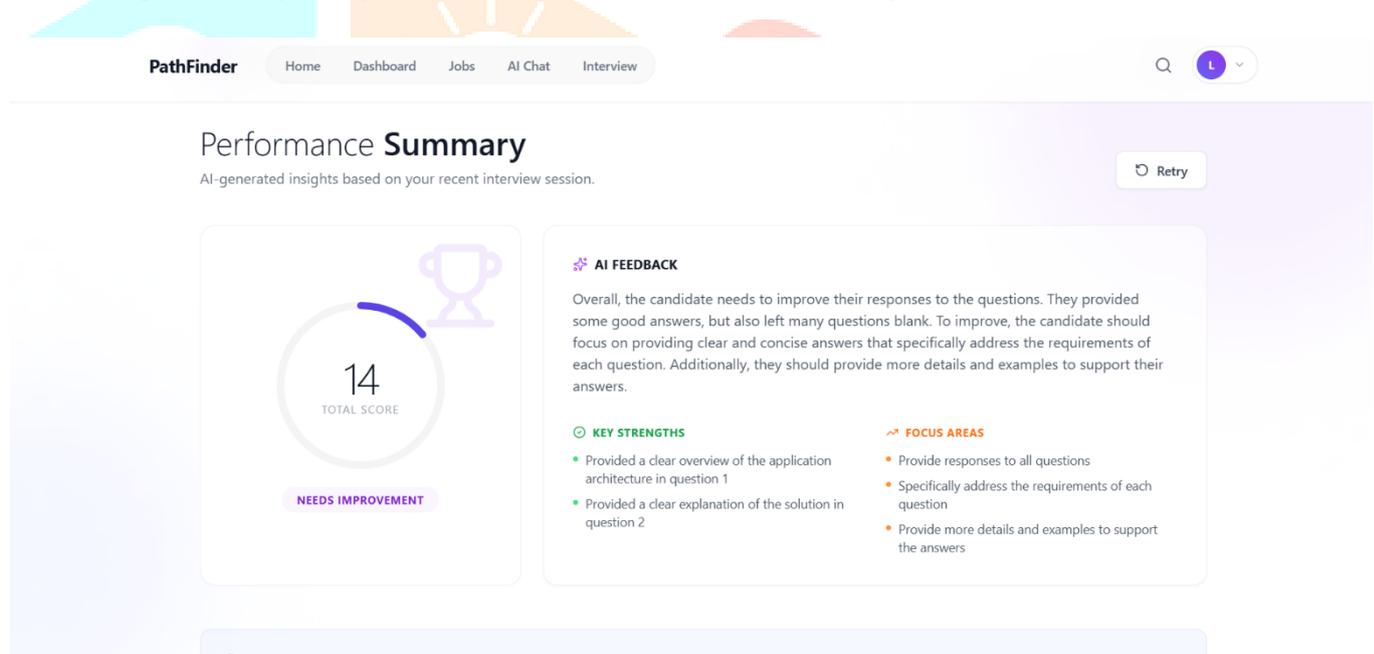
### 5.2 Skill Gap Analysis and Learning Path Evaluation:

The skill gap analysis module compared extracted user skills with target domain requirements. The system generated structured learning paths outlining the missing skills and recommended progression steps. Results showed that the learning paths were coherent, logically ordered, and tailored to individual user profiles. Users were able to clearly understand which skills needed improvement and how to approach domain mastery. The retrieval-augmented intelligence layer ensured that recommendations were contextually relevant and aligned with current industry practices.

Resume	Matched skills	Missing Skills	Accuracy(%)
R1	12	4	87
R2	10	6	81
R3	14	3	90

### 5.3 Mock Interview Performance Analysis:

The mock interview module generated role-specific interview questions covering technical, conceptual, and behavioral aspects. User responses were evaluated based on relevance, clarity, and completeness. Experimental observations indicated that repeated mock interview sessions led to measurable improvement in response quality. Users demonstrated increased confidence, improved articulation, and better alignment with expected interview standards over successive attempts. Feedback provided by the system was found to be actionable and easy to understand.



### 5.4 Overall Results Summary:

The experimental results validate the effectiveness of PathFinder as a comprehensive career guidance platform. The system successfully integrates intelligent resume analysis, semantic job matching, personalized learning recommendations, mock interview simulation, and explainable feedback. The modular design ensures scalability and supports future extensions, making PathFinder a practical and adaptable solution for career development and job readiness.

## VI. FUTURE SCOPE

Beyond matching, PathFinder AI performs automated skill gap analysis by analyzing discrepancies between candidate profiles and industry-aligned job embeddings. It generates structured learning roadmaps tailored to individual career goals, enabling candidates to bridge gaps systematically. The system also integrates AI-driven mock interviews, where responses are evaluated based on semantic relevance, communication clarity, and technical correctness, providing constructive feedback rather than generic scoring.

Another key strength of PathFinder AI is explainability. Through retrieval-augmented generation mechanisms, the system provides context-aware explanations for recommendations, helping users understand the rationale behind each suggestion. This improves trust, transparency, and user engagement.

Although PathFinder AI demonstrates effective semantic resume analysis and intelligent job matching capabilities, there remains significant scope for further enhancement and research exploration. Future work may focus on integrating real-time job market APIs to provide dynamic and continuously updated career recommendations aligned with current industry demands.

The system can be extended by incorporating advanced adaptive learning techniques, enabling continuous performance improvement through user interaction feedback. Reinforcement learning models may further enhance interview question generation and personalized feedback mechanisms.

## VII. CONCLUSION

This work presented **PathFinder**, an intelligent and modular career guidance system designed to support users throughout their professional development journey. The system integrates resume analysis, semantic job matching, personalized learning path generation, mock interview simulation, and conversational assistance into a unified platform. By combining intelligent data processing with retrieval-based guidance, PathFinder addresses key limitations of traditional career recommendation systems that rely solely on keyword matching or static rules.

The experimental results reveal that PathFinder can successfully identify pertinent job roles, identify skill gaps, and offer learning recommendations according to individual user profiles. The mock interview module can enhance the level of job readiness by simulating real-world interview scenarios and offering feedback, thus allowing users to improve their skills in terms of both technology and communication skills. The conversational assistant can maintain user engagement through interactive and context-aware support for all system functionalities.

## VIII. REFERENCES

- [1] SAMSUN A., ANGEL CERLI A. *RESUME PARSER USING NATURAL LANGUAGE PROCESSING AND MACHINE LEARNING*. **INTERNATIONAL JOURNAL OF ADVANCE RESEARCH IN MULTIDISCIPLINARY**, VOL. 3, ISSUE 2, 2025.  
AVAILABLE: <https://zenodo.org/records/15614328>
- [2] Y. SAGAR, K. S. G. PRAKEERTH, G. ABHIRAM, N. MAHIDEEP, M. POOJITH. *INTELLIGENT RESUME MATCHING SYSTEM*. **IJRASET**, 2025.  
AVAILABLE: <https://www.ijraset.com/best-journal/intelligent-resume-matching-system>
- [3] LEWIS, P., ET AL. (2021). *RETRIEVAL-AUGMENTED GENERATION FOR KNOWLEDGE-INTENSIVE NLP TASKS*.  
AVAILABLE: [https://arxiv.org/abs/2005.11401?utm\\_source=copilot.com](https://arxiv.org/abs/2005.11401?utm_source=copilot.com)
- [4] TOKOLI ET AL. (2026). *ALIGNAGENT: ADAPTIVE LEARNER INTELLIGENCE FOR GAP IDENTIFICATION AND NEXT-STEP GUIDANCE*.  
AVAILABLE: <https://arxiv.org/abs/2601.15551>
- [5] RENJI ET AL. (2025). *STEVE: LLM POWERED CHATBOT FOR CAREER PROGRESSION*  
AVAILABLE: [HTTPS://ARXIV.ORG/ABS/2504.03789](https://arxiv.org/abs/2504.03789)
- [6] ZHENG ET AL. (2023). *GENERATIVE JOB RECOMMENDATIONS WITH LARGE LANGUAGE MODEL*.  
AVAILABLE: <https://arxiv.org/abs/2309.11805>

[7] SANJANA ET AL. (2025). *A SYSTEMATIC REVIEW OF AI-DRIVEN INTERVIEWING SYSTEMS FOR TECHNICAL AND PROFESSIONAL SKILLS.*

AVAILABLE: <https://iscap.us/proceedings/2025/pdf/6438.pdf>

[8] ZHU ET AL. (2024). *LAYOUT-AWARE PARSING MEETS EFFICIENT LLMs: A UNIFIED, SCALABLE FRAMEWORK FOR RESUME INFORMATION EXTRACTION AND EVALUATION.*

AVAILABLE: <https://arxiv.org/abs/2510.09722>

[9] **A COMPREHENSIVE SURVEY OF RETRIEVAL-AUGMENTED GENERATION (RAG): EVOLUTION, CURRENT LANDSCAPE AND FUTURE DIRECTIONS.** S. GUPTA, R. RANJAN, S. N. SINGH (2024).

AVAILABLE: <https://arxiv.org/abs/2410.12837>

[10] **Springer BISE (2025)** — Reviews RAG architecture with focus on non-parametric vector memory and enterprise use "Retrieval-Augmented Generation (RAG)"

AVAILABLE: <https://link.springer.com/article/10.1007/s12599-025-00945-3>

