CareerPath AI: An Intelligent AI-Driven Job Recommendation and Application Automation System

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Abstract - The modern job market presents significant challenges for students and fresh graduates due to information overload, irrelevant job listings, and time-consuming application processes. Traditional job portals rely on keyword-based filtering, which often fails to capture contextual relevance between candidate profiles and job requirements. To address these limitations, this paper proposes CareerPath AI, an intelligent job recommendation and automation platform that leverages Artificial Intelligence and Natural Language Processing (NLP) techniques.

The system utilizes a Large Language Model, Google Gemini, to analyze resumes and extract structured information such as skills, projects, and experience. A semantic matching engine based on NLP embeddings compares candidate profiles with job descriptions to provide highly relevant job recommendations. Additionally, the platform integrates public job APIs for real-time job retrieval and automatically generates personalized cover letters for each application.

The system is implemented using React for the frontend, Node.js for backend services, and Firebase for data storage. Experimental results demonstrate improved efficiency, reduced manual effort, and enhanced accuracy in job matching. The proposed solution provides a scalable and intelligent approach to modernizing the job search process.

Key Words: Job Recommendation System, Resume Analysis, Natural Language Processing, Semantic Matching, Google Gemini, CareerPath AI, Artificial Intelligence.

1.INTRODUCTION

The rapid growth of digital platforms has transformed the job search process, providing students and fresh graduates with access to a vast number of employment opportunities. However, this abundance of information has also created significant challenges, including information overload, irrelevant job listings, and time-consuming application procedures. Traditional job portals primarily rely on keyword-based filtering, which often fails to capture the contextual relationship between a candidate's skills and job requirements. As a result, users are required to manually search, filter, and customize applications, making the process inefficient and exhausting.

In recent years, advancements in Artificial Intelligence (AI), Natural Language Processing (NLP), and Large Language Models (LLMs) have opened new possibilities for improving job recommendation systems. These technologies enable deeper semantic understanding of text, allowing systems to analyze resumes and job descriptions more effectively. By leveraging AI-driven approaches, it is possible to automate and personalize the job search process, improving both efficiency and accuracy.

This research proposes *CareerPath AI*, an intelligent job recommendation and automation platform designed to assist students and fresh graduates in finding relevant job opportunities. The system utilizes advanced AI techniques, including resume analysis using a Large Language Model (Google Gemini), semantic job matching using NLP embeddings, and automated cover letter generation. By integrating real-time job data from external APIs and applying context-aware matching techniques, the system provides personalized job recommendations and reduces manual effort in the application process.

1.1 Background of Job Search Systems

Traditional job search systems such as LinkedIn, Indeed, and Glassdoor have become widely used platforms for finding employment opportunities. These platforms allow users to search for jobs using keywords, filters, and categories. While they provide access to a large number of job listings, they often lack personalization and intelligent matching capabilities.

Most existing systems rely on keyword-based algorithms, which do not fully understand the contextual meaning of user profiles or job descriptions. For example, a candidate with relevant skills may not receive appropriate job recommendations due to differences in terminology. Additionally, users are required to manually customize resumes and cover letters for each application, making the process repetitive and time-consuming.

1.2 Importance of Intelligent Job Recommendation

An intelligent job recommendation system plays a crucial role in improving the efficiency of the job search process. By analyzing user profiles and job descriptions using AI techniques, such systems can provide personalized recommendations that match the candidate's skills, interests, and experience.Semantic matching using NLP allows the system to understand the contextual relationship between words rather than relying solely on exact keyword matches. This leads to more accurate and meaningful job recommendations. Furthermore, automation of tasks such as resume analysis and cover letter generation reduces the workload on users and increases their chances of securing suitable opportunities.

1.3 Role of AI, NLP, and Data Integration

Artificial Intelligence and Natural Language Processing are key components of modern intelligent systems. In CareerPath AI, a Large Language Model such as Google Gemini is used to analyze resumes and extract structured information, including skills, education, projects, and experience.The system integrates data from multiple sources, including user resumes and external

job APIs, to create a comprehensive job recommendation framework. NLP-based semantic matching techniques are used to compare candidate profiles with job descriptions, ensuring context-aware matching.Additionally, the system generates personalized cover letters using AI, which enhances the quality of job applications and improves user productivity. The integration of these technologies enables the development of a smart and efficient job search platform.

1.4 Motivation of the Proposed System

Despite the availability of various job portals, many existing systems lack personalization, automation, and intelligent matching capabilities. Users often face challenges such as irrelevant job recommendations, repetitive application tasks, and difficulty in identifying suitable opportunities.The motivation behind CareerPath AI is to address these limitations by developing a comprehensive AI-driven platform that simplifies and enhances the job search process. The system aims to provide accurate job recommendations, automate application-related tasks, and improve the overall user experience.By combining resume analysis, semantic job matching, real-time job retrieval, and automated content generation, the proposed system offers a complete solution for modern job searching. It not only reduces time and effort but also increases the likelihood of finding relevant and suitable job opportunities.

2. PROPOSED SYSTEM

The proposed system, *CareerPath AI*, is an intelligent job recommendation and automation platform designed to simplify and enhance the job search process for students and fresh graduates. The system integrates Artificial Intelligence, Natural Language Processing (NLP), and real-time job data to provide personalized job recommendations and automate application tasks. Unlike traditional job portals that rely on keyword-based matching, the proposed system uses semantic analysis to understand contextual relationships between candidate profiles and job descriptions.

The system consists of multiple interconnected modules, including resume analysis, job data integration, semantic matching, personalized content generation, and an interactive dashboard. These components work together to create a seamless and efficient job search experience.

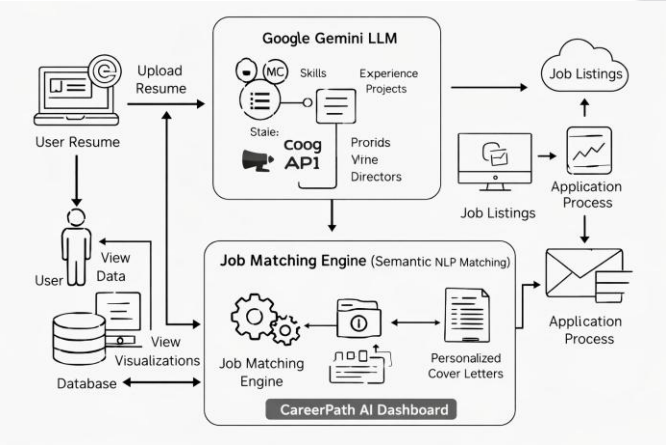

Fig. 1 illustrates the overall system architecture of the proposed CareerPath AI system, showing the interaction between user resume input, AI-based resume analysis using Google Gemini, job data retrieval from external APIs, semantic job matching engine, and the user interface. The system processes resume data to generate structured profiles, matches them with relevant job listings, and provides personalized recommendations along with automated cover letter generation through an interactive dashboard.

2.1 ResumeData Acquisition and Profile Generation

The proposed system begins by collecting user data through resume uploads. Users upload their resumes in various formats such as PDF or DOCX through the web interface. The system extracts textual content from the resume and processes it for further analysis.A Large Language Model, such as Google Gemini, is used to analyze the extracted text and convert it into a structured profile. This structured data includes key attributes such as skills, education, projects, certifications, and work experience. The transformation of unstructured resume data into a structured format enables efficient processing and accurate job matching.The generated user profile is stored in a centralized database, which can be reused for job recommendations and application processes.

2.2 Job Data Acquisition and Integration

The system retrieves real-time job listings from multiple external job APIs and online platforms. These APIs provide updated information about job roles, company details, required skills, job descriptions, and application links.The collected job data is preprocessed and standardized to ensure consistency across different sources. By integrating multiple job platforms, the system ensures comprehensive coverage of available opportunities.This integration allows the system to continuously update job listings and provide users with the most relevant and recent opportunities based on their profiles.

2.3 Semantic Job Matching Using NLP

To provide accurate job recommendations, the system employs Natural Language Processing (NLP) techniques for semantic matching. Unlike traditional keyword-based approaches, semantic matching analyzes the contextual meaning of both user profiles and job descriptions.

The system generates embeddings for user profiles and job data, which represent the semantic meaning of text. These embeddings are compared using similarity measures such as cosine similarity to identify the best matches.

This approach enables the system to recommend jobs that align closely with the user's skills and experience, even when exact keywords are not present. As a result, the system significantly improves the relevance and accuracy of job recommendations.

2.4 Personalized Cover Letter Generation

An important feature of the proposed system is the automatic generation of personalized cover letters. Once a user selects a job, the system combines the user's profile data with the job description to generate a customized cover letter.This process is powered by a Large Language Model such as Google Gemini, which generates human-like, context-aware content. The generated cover letters are tailored to specific job roles, highlighting relevant skills and experiences.This feature reduces the time and effort required for writing cover letters manually and improves the overall quality of job applications.

2.5 Visualization and Interactive Dashboard

The processed data and system outputs are presented through an interactive dashboard designed to enhance user experience. The dashboard displays personalized job recommendations, match scores, and relevant job details.Users can view job listings, filter results based on preferences, and track saved or applied jobs. The system also provides insights into why a job matches the user's profile, improving transparency and understanding.The dashboard ensures a user-friendly interface that allows easy navigation and efficient interaction with the system.

3. IMPLEMENTATION DETAILS

The implementation of the proposed *CareerPath AI* system focuses on developing an intelligent and scalable platform capable of analyzing user resumes, retrieving job data, performing semantic matching, and generating personalized application content. The system integrates modern web technologies, Artificial Intelligence, and Natural Language Processing (NLP) techniques to ensure efficient data processing and accurate job recommendations.The overall implementation process includes resume data acquisition, data preprocessing, profile generation, job data integration, semantic matching, and visualization through an interactive user interface.

3.1 Resume Data Acquisition and API Integration

The first stage of implementation involves collecting user data through resume uploads. Users upload their resumes via the web interface in formats such as PDF or DOCX. The system extracts textual content from these documents using parsing techniques.

The extracted resume data is then processed using a Large Language Model (LLM), such as Google Gemini. The API integration with the LLM enables the system to analyze unstructured resume text and convert it into structured information, including skills, education, projects, and experience.

The processed data is then stored in the system database, ensuring that both raw and structured user information is available for further processing and job matching.

3.2 Data Preprocessing and Storage

After acquiring resume data, preprocessing is performed to improve data quality and consistency. This includes removing unnecessary information, standardizing text formats, and organizing extracted data into structured fields.

The system ensures that important attributes such as skills, experience, and qualifications are clearly identified and stored. The cleaned and structured data is saved in a centralized database (Firebase), which supports efficient retrieval and real-time updates.Additionally, the database maintains user profiles and job-related data, enabling continuous learning and improved recommendation accuracy over time.

3.3 Profile Generation Module

The profile generation module converts preprocessed resume data into a structured user profile. This profile includes key elements such as technical skills, soft skills, academic background, projects, and work experience.The structured profile serves as the foundation for job matching and recommendation. By organizing user data in a standardized format, the system enables efficient comparison between user profiles and job requirements.This module plays a crucial role in ensuring that the system understands the user's capabilities and preferences accurately

3.4 Job Matching Engine Implementation

The job matching engine is implemented using Natural Language Processing (NLP) techniques. The system generates semantic embeddings for both user profiles and job descriptions to represent their contextual meaning.These embeddings are compared using similarity measures such as cosine similarity to identify relevant job matches. The system ranks job listings based on match scores, ensuring that the most suitable opportunities are presented to the user.This semantic approach improves matching accuracy compared to traditional keyword-based systems and enables context-aware job recommendations.

3.5 Cover Letter Generation Module

The system includes a cover letter generation module that automates the creation of personalized application content. When a user selects a job, the system combines user profile data with job description details.

Using a Large Language Model such as Google Gemini, the system generates a tailored cover letter that highlights relevant skills and experiences. The generated content is human-like, context-aware, and customized for each job application.This feature significantly reduces manual effort and improves the quality and consistency of job applications.

4. RESULTS AND PERFORMANCE ANALYSIS

The performance of the proposed *CareerPath AI* system was evaluated by analyzing its ability to process user resumes, generate structured profiles, retrieve real-time job listings, perform semantic job matching, and automate the job application process through personalized content generation. The system successfully integrates Artificial Intelligence, Natural Language Processing (NLP), and external job APIs to provide accurate and relevant job recommendations.

The implementation results demonstrate that the system effectively extracts meaningful information from user resumes and converts it into structured profiles containing skills, experience, and projects. This structured data enables efficient comparison with job descriptions, resulting in highly relevant job matches. The system retrieves job listings from multiple sources and ranks them based on semantic similarity, ensuring that users receive personalized recommendations.

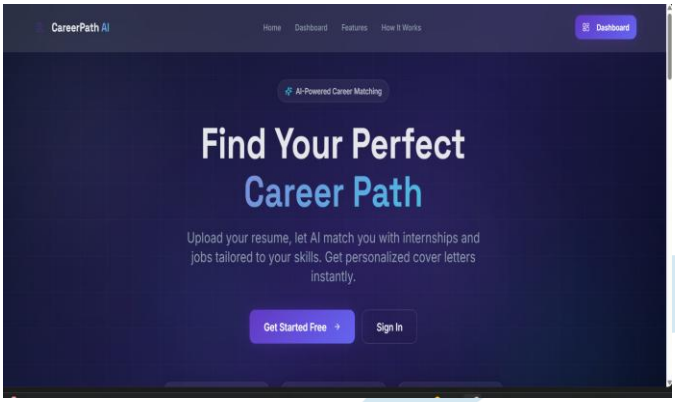

Fig. 2 shows the home page of the CareerPath AI application, where users can start the job search process by uploading their resume. The interface provides simple navigation options such as "Get Started Free" and "Sign In," ensuring a user-friendly and intuitive experience.

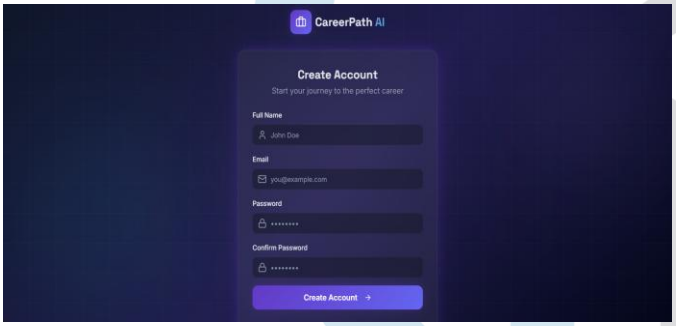

Fig. 3 shows the registration page of the CareerPath AI application, where users can create a new account by entering basic details.

The dashboard visualization provides insights into job relevance by displaying matched skills, job descriptions, and similarity scores. Users can filter job listings, save preferred jobs, and directly access application links. This interactive interface improves usability and enhances the overall job search experience.

In addition to job recommendations, the system includes a cover letter generation module that automatically creates personalized content based on the user's profile and selected job. This feature reduces manual effort and ensures consistency in job applications.

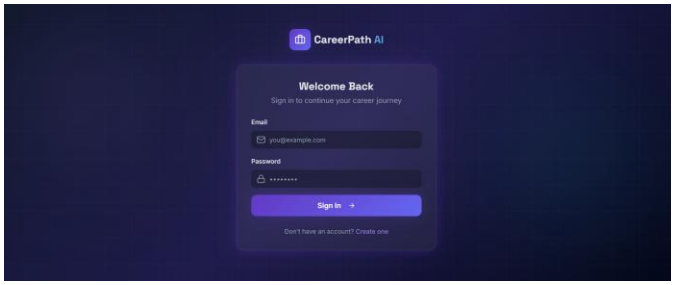

Fig. 4 the login page of the CareerPath AI application

The experimental results indicate that integrating Artificial Intelligence and Natural Language Processing significantly improves the efficiency and usability of job recommendation systems. The proposed system successfully provides personalized job recommendations, automated resume analysis, and intelligent cover letter generation, making it a valuable tool for students and fresh graduates. Overall, the results confirm that the developed system effectively combines resume processing, semantic matching, real-time job data integration, and interactive visualization to deliver accurate and user-friendly job search solutions. The application demonstrates the potential of AI-driven systems in enhancing the recruitment process and improving career opportunities.

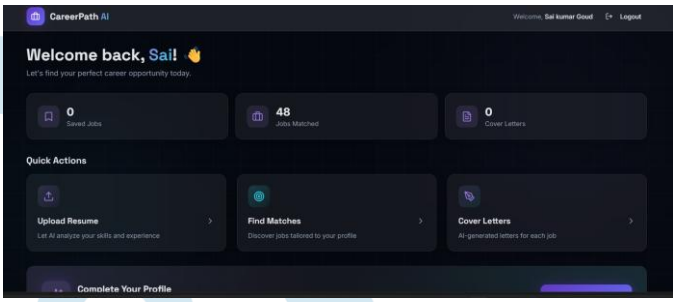

Fig. 5 Welcome Page of the CareerPath AI

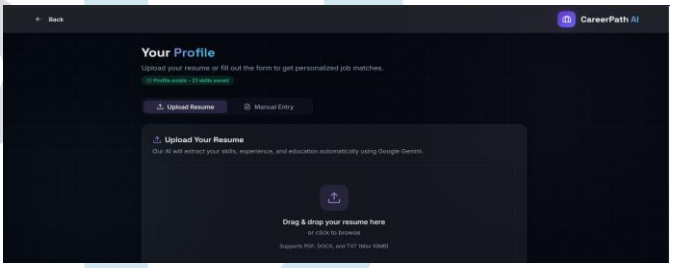

Fig. 5 Resume Upload Page

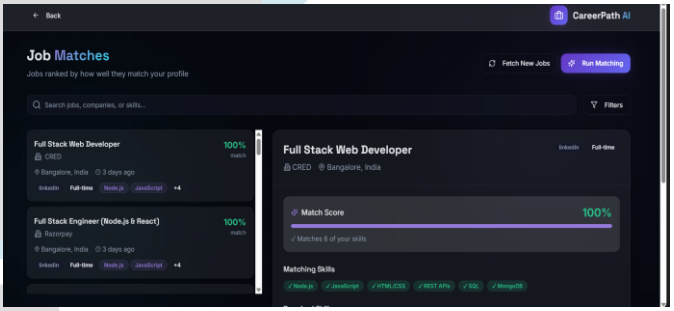

Fig. 6 Job Fetching Page

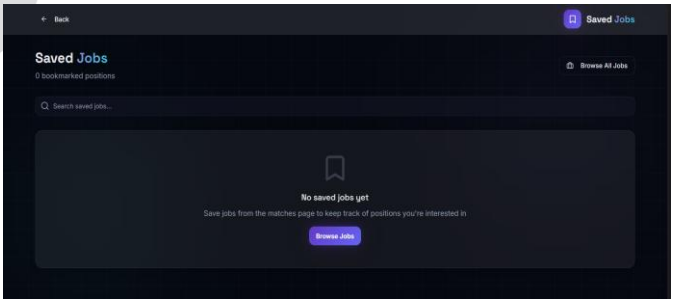

Fig. 7 Saved Jobs Page

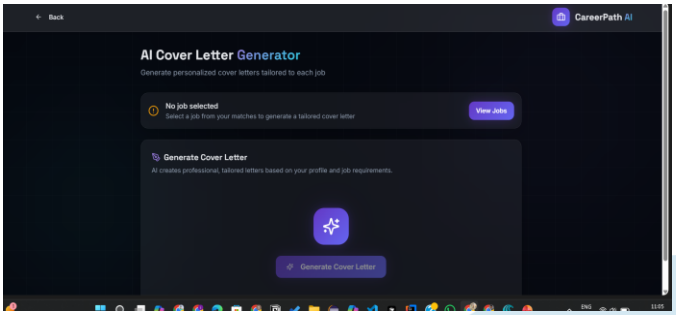

Fig. 8 AI Cover Letter Generator

5. CONCLUSIONS

The job search process for students and fresh graduates has become increasingly complex due to the large volume of available opportunities and the lack of personalized filtering mechanisms. The proposed *CareerPath AI* system was developed to provide an intelligent, automated, and user-friendly solution for job recommendation and application processes. The system successfully integrates Artificial Intelligence, Natural Language Processing, and real-time job data to deliver accurate and personalized job recommendations through an interactive web-based platform.

The implementation of the system demonstrates that integrating AI-based resume analysis with semantic job matching techniques significantly improves the efficiency and relevance of job recommendations. The use of a Large Language Model such as Google Gemini enables the system to extract structured information from resumes and generate personalized cover letters, reducing manual effort and enhancing application quality. The interactive dashboard further improves user experience by presenting job matches, match scores, and relevant insights in a clear and intuitive manner.

In addition to job recommendation, the system provides automation features that simplify the application process, allowing users to focus on selecting suitable opportunities rather than performing repetitive tasks. This improves productivity and increases the chances of securing relevant job roles. By combining resume analysis, real-time job data integration, semantic matching, and automated content generation, the proposed system offers a comprehensive solution for modern job searching.

Overall, the developed application demonstrates the potential of AI-driven systems in transforming the recruitment process. The proposed framework can assist students, job seekers, and organizations in improving job matching accuracy, enhancing user experience, and creating more efficient and intelligent hiring ecosystems.

6. FUTURE WORK

Although the proposed *CareerPath AI* system successfully provides personalized job recommendations, resume analysis, and automated cover letter generation, several enhancements can be made to further improve its capabilities and effectiveness. The current system focuses on semantic matching and AI-based automation; however, integrating more advanced technologies can enhance recommendation accuracy and overall system performance. In future work, the system can be extended by incorporating advanced deep learning models and recommendation algorithms to improve job matching by analyzing user behavior, preferences, and interaction patterns over time.

Another possible enhancement is the integration of additional job platforms and APIs to increase the diversity and availability of job opportunities. Expanding the system to include global job sources and company-specific portals can provide users with a wider range of career options. The application can also be developed as a mobile platform to improve accessibility and user engagement. A mobile application with real-time notifications can alert users about new job opportunities, application deadlines, and personalized recommendations.

In addition, future versions of the system can include features such as skill gap analysis, career guidance, and interview preparation support. By identifying missing skills required for specific job roles, the system can recommend learning resources and certification programs to help users improve their profiles. Integration of mock interview systems and AI-based feedback can further enhance user readiness for job applications.

Finally, incorporating advanced analytics and visualization tools can provide deeper insights into job trends, in-demand skills, and career growth opportunities. These enhancements would make the system more intelligent, adaptive, and effective in supporting students and job seekers in achieving their career goals.

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