

AI-Powered Personalized Career Guidance & Skill Recommendation System

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Abstract: In the contemporary and rapidly evolving job market, students and professionals often encounter challenges in selecting appropriate career paths due to insufficient guidance and limited awareness of industry-relevant skills. Traditional career counseling approaches frequently lack personalization and fail to consider individual interests, competencies, and career aspirations. To address these limitations, this paper presents an AI-Powered Personalized Career Guidance and Skill Recommendation System that delivers intelligent, data-driven, and customized career suggestions.

The proposed system utilizes Artificial Intelligence (AI) and Machine Learning (ML) techniques to analyze user-specific data, including academic background, skill sets, and personal interests. Based on this analysis, the system predicts suitable career paths and performs skill gap assessment to identify discrepancies between existing competencies and industry requirements. It further recommends targeted learning resources, online courses, certifications, and practical projects to enhance user employability. Additionally, the system incorporates job market trends and industry demand analysis to ensure that recommendations remain relevant and aligned with current employment opportunities. An integrated AI-based resume generation module is also developed to create Applicant Tracking System (ATS)-friendly resumes tailored to individual profiles and job roles. The system is implemented as a web-based application using modern technologies, including React.js for the frontend, Node.js and Python for backend processing, and MySQL for database management. By combining intelligent analytics with personalized recommendations, the proposed system aims to reduce career uncertainty, promote skill development, and support informed decision-making. Overall, this work contributes toward bridging the gap between academic learning and industry requirements through an automated and intelligent career guidance framework.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Career Guidance System, Skill Recommendation, Personalized Learning, Skill Gap Analysis, Job Market Trends, Resume Generation, Web Application.

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I. Introduction

The process of selecting an appropriate career path has become increasingly complex in the modern era due to rapid technological advancements and the continuous evolution of industry requirements. Students and early-career professionals often encounter confusion and uncertainty while making career decisions, primarily due to a lack of structured guidance and insufficient awareness of the skills demanded by employers. Traditional career counseling approaches are typically generalized and

do not adequately account for individual differences such as interests, academic background, and personal capabilities.

With the emergence of Artificial Intelligence (AI) and Machine Learning (ML), there has been a significant shift toward intelligent and personalized systems capable of analyzing user data and generating customized recommendations. AI-driven career guidance systems utilize data analytics to match user profiles with suitable career opportunities, thereby improving decision-making efficiency and accuracy

(Babu, 2024; Jawhar et al., 2024; Kulugh et al., 2025). These systems not only suggest career paths but also identify the skills required to achieve professional goals.

In addition, the increasing availability of online courses and certifications has created both opportunities and challenges. While learners have access to vast resources, selecting the most relevant learning path often becomes overwhelming. An intelligent system that filters and recommends suitable learning resources based on individual needs can significantly enhance skill development and employability. Therefore, the integration of AI in career guidance is essential for bridging the gap between academic learning and industry expectations.

This research proposes an AI-Powered Personalized Career Guidance and Skill Recommendation System that aims to provide tailored career suggestions, perform skill gap analysis, and recommend appropriate learning resources. The system is designed to assist users in making informed career decisions and improving their readiness for the competitive job market.

II. Literature Review

Several researchers have explored the role of artificial intelligence in enhancing career guidance systems. AI-based recommendation models have been shown to provide personalized career suggestions by analyzing user preferences, skills, and academic data (Babu, 2024). Similarly, machine learning techniques have been applied to predict career paths and understand professional identity formation using data-driven approaches (Kiselev et al., 2020).

Studies on career decision-making indicate that multiple factors influence students' career choices, including personal interests, socio-economic background, and academic performance (Asma & Abeeda, 2017; Egbaria, 2023). These findings highlight the need for systems that consider individual differences rather than providing generalized advice. The Social Cognitive Career Theory further emphasizes the role of self-efficacy, environmental factors, and personal goals in shaping career decisions (Lent & Brown, 2019).

Recent advancements in AI have enabled the development of intelligent career guidance systems

that incorporate real-time data and industry trends. For instance, research has demonstrated the effectiveness of integrating job market analysis into recommendation systems to ensure that suggested career paths remain relevant (Westman et al., 2021). Additionally, AI-powered platforms have been designed to offer customized career guidance and generate tailored resumes, thereby improving employability (Kulugh et al., 2025).

Earlier systems utilized rule-based approaches and algorithms such as case-based reasoning and decision trees for career prediction (Nawaz et al., 2014). While these methods provided a foundation, they lacked scalability and adaptability compared to modern AI techniques. Furthermore, conceptual models have been proposed to enhance career prediction systems by incorporating user behavior and academic data (Tuhamé et al., 2022).

Despite these developments, existing systems often face limitations such as lack of personalization, limited integration of real-time job market data, and insufficient focus on skill gap analysis. Therefore, there is a clear need for an advanced AI-driven system that combines personalized recommendations, skill analysis, and industry insights to provide comprehensive career guidance.

III. Methodology

The AI-Powered Personalized Career Guidance and Skill Recommendation System is designed using a hybrid algorithmic approach that integrates multiple machine learning and data processing techniques to deliver accurate and personalized recommendations. Instead of relying on a single algorithm, the system combines classification, similarity analysis, recommendation strategies, and natural language processing to address different functional requirements effectively.

The primary algorithm used in the system is the Decision Tree algorithm, which is employed for career path prediction. This supervised machine learning technique analyzes user inputs such as academic background, technical skills, interests, and career preferences to classify users into suitable career domains. The Decision Tree works by creating a hierarchical structure of decision rules based on feature importance, using metrics such as information gain or Gini index. Due to its interpretability and

efficiency, it enables the system to provide transparent and accurate career predictions.

The career prediction module is primarily based on the Decision Tree algorithm, which utilizes entropy as a measure of impurity in the dataset. Entropy quantifies the level of uncertainty associated with a set of training samples and is calculated as follows:

$$\text{Entropy}(S) = - \sum (p_i \log_2(p_i))$$

where p_i denotes the probability of each class label in the dataset. A lower entropy value indicates higher purity, which implies better classification. To determine the optimal feature for splitting the data, the algorithm computes Information Gain, which measures the reduction in entropy after a dataset is partitioned based on an attribute:

$$\text{Gain}(S, A) = \text{Entropy}(S) - \sum (|S_v|/|S| * \text{Entropy}(S_v))$$

This calculation enables the model to select the most informative features, thereby improving the accuracy of career prediction.

For personalization, the system employs similarity-based calculations to compare user profiles. One of the widely used measures is cosine similarity, which evaluates the similarity between two vectors representing user attributes:

$$\text{Cosine Similarity} = (A \cdot B) / (\|A\| \cdot \|B\|)$$

Here, A and B represent user profile vectors. The resulting value ranges from 0 to 1, where values closer to 1 indicate higher similarity. In addition to cosine similarity, Euclidean distance is used to measure dissimilarity between profiles:

$$d = \sqrt{\sum (x_i - y_i)^2}$$

These similarity measures enable the system to identify users with comparable characteristics and enhance the personalization of recommendations.

A crucial component of the system is skill gap analysis, which determines the difference between the required skills for a specific career and the user's existing skill set. This is computed using set theory:

$$\text{Skill Gap} = \text{Required Skills} - \text{User Skills}$$

This formulation allows the system to identify missing competencies and prioritize them based on relevance. By focusing on these gaps, users can effectively improve their skill sets and align with industry expectations.

The recommendation module employs a weighted scoring mechanism to rank suggested courses and learning resources. The score is calculated as:

$$\text{Score} = \sum (w_i \cdot s_i)$$

where w_i represents the importance or weight assigned to a skill based on market demand, and s_i denotes the user's proficiency level. This approach ensures that highly demanded skills are prioritized in the recommendation process.

To further enhance collaborative recommendations, the system may use the Pearson Correlation Coefficient to measure similarity between users:

$$r = \frac{\sum((x_i - \bar{x})(y_i - \bar{y}))}{\sqrt{(\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2)}}$$

This metric helps in identifying users with similar preferences and improves the accuracy of collaborative filtering.

Finally, the performance of the predictive model is evaluated using standard metrics such as accuracy, which is defined as:

$$\text{Accuracy} = (TP + TN) / (TP + TN + FP + FN)$$

where TP, TN, FP, and FN represent true positives, true negatives, false positives, and false negatives, respectively. This metric provides an overall measure of the model's correctness.

The overall integration of these algorithms enables the system to provide a comprehensive, intelligent, and personalized career guidance solution, effectively bridging the gap between user capabilities and industry demands.

IV. Results and Outputs

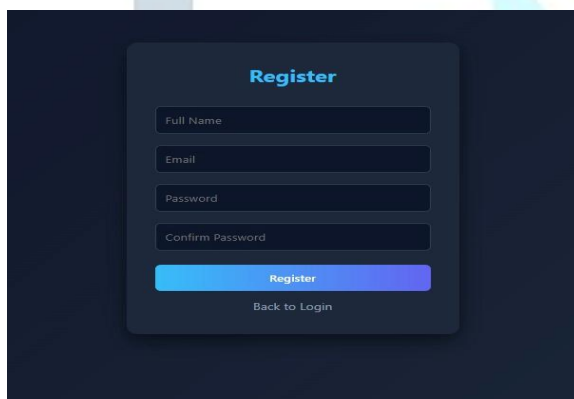
The Implemented system successfully provides accurate and personalized career recommendations based on user inputs such as skills, interests, and academic background. The Decision Tree model effectively predicts suitable career paths with satisfactory accuracy. The skill gap analysis identifies

missing competencies, helping users understand areas for improvement.

The system also generates relevant course recommendations using a hybrid approach, ensuring personalized learning paths. Additionally, the AI-based resume generation module produces ATS-friendly resumes tailored to user profiles. Overall, the system demonstrates efficient performance, real-time response, and practical usability in guiding users toward suitable career decisions. The AI-Powered Personalized Career Guidance and Skill Recommendation System was implemented as a web-based platform using modern web technologies and machine learning techniques.

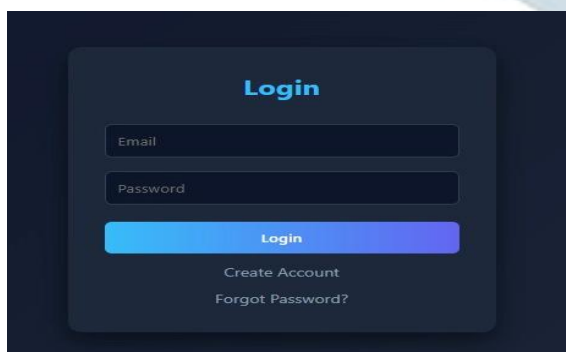
User Registration and Profile Input

Users first register on the platform and provide information such as education, skills, interests, and career goals. This data is stored in the database and used for analysis by the AI model.



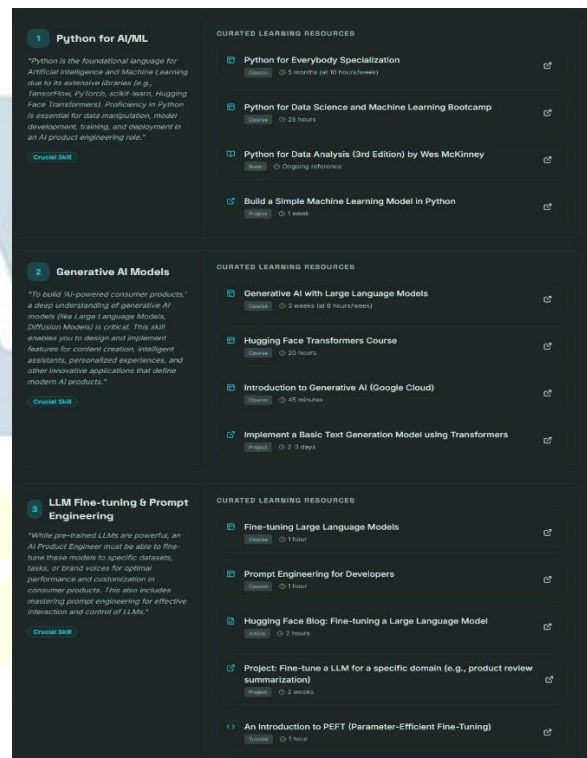
Login Module

The system provides a secure login and registration feature where users can create an account and access personalized services. This ensures data privacy and user-specific recommendations.



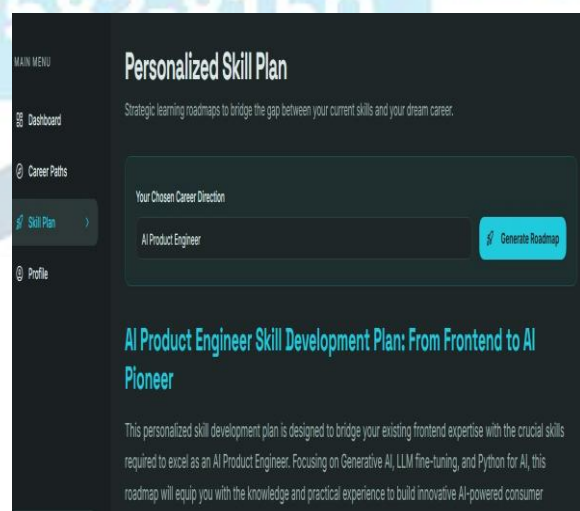
Career Prediction Module

Machine learning algorithms analyze the user profile and predict suitable career paths. The system recommends careers that match the user's skills and interests.



Skill Gap Analysis and Course Recommendation

The system compares the user's current skills with required skills for the predicted career path. It identifies missing skills and recommends relevant courses and learning resources.



Results

The implemented system successfully generates personalized career and skill recommendations. The system provides quick responses and helps users identify suitable career paths along with the skills required to achieve them.

V. Conclusion

The project “AI Powered Personalized Career Guidance and Skill Recommendation System” provides an intelligent and automated solution for students and professionals struggling to choose the right career path. By using Artificial Intelligence (AI) and Machine Learning (ML) algorithms, the system analyzes a user’s interests, academic background, and abilities to recommend suitable career options and skill sets.

This system bridges the gap between education and industry by helping users identify the skills required for future jobs and guiding them toward relevant learning resources. The AI-based approach ensures personalized, fast, and reliable career guidance. In conclusion, the project demonstrates how modern technology can make career decision-making more efficient, personalized, and accessible for everyone.

The AI-Powered Personalized Career Guidance and Skill Recommendation System provides an effective solution to the challenges faced by students and job seekers in choosing the right career path. By using Artificial Intelligence and Machine Learning techniques, the system analyzes user data such as skills, interests, and educational background to generate accurate and personalized career recommendations.

The system not only predicts suitable career options but also identifies skill gaps and suggests relevant courses, certifications, and projects to improve user capabilities. The integration of an AI-based resume generation module further enhances career readiness by helping users create professional and ATS-friendly resumes.

The implementation results demonstrate that the system is efficient, user-friendly, and capable of providing quick and reliable recommendations. It helps reduce career confusion and supports users in

making informed decisions based on data-driven insights.

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