Career Guidance and Placement Recommendation System Using K-NN and NLP

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***Abstract*—** Career selection and placement preparation are critical challenges faced by engineering students due to rapidly changing industry requirements and the increasing demand for specialized skills. Traditional career counseling approaches often provide generic recommendations and lack personalized guidance based on individual skills, interests, and academic performance. This paper presents an Intelligent Career Guidance and Placement Recommendation System that integrates K-Nearest Neighbor (KNN) and Natural Language Processing (NLP) techniques to assist students in identifying suitable career paths and improving placement readiness.

The proposed system analyzes student profiles consisting of academic performance, technical skills, certifications, interests, projects, and resume content. KNN is employed to recommend career domains by identifying similarities between student profiles and predefined career datasets. NLP techniques are utilized for resume analysis, skill extraction, keyword matching, and skill-gap identification. The system also incorporates interview assessment and placement readiness evaluation modules to provide comprehensive career support.

The proposed framework aims to bridge the gap between academic learning and industry expectations by delivering personalized recommendations and actionable insights. The system can assist students in selecting appropriate career paths such as Software Development, Data Science, Cybersecurity, Cloud Computing, and Artificial Intelligence while identifying areas for improvement. The proposed solution contributes to enhanced employability, better career planning, and improved placement outcomes through intelligent and data-driven recommendations.

Keywords: Career Guidance, Placement System, K-Nearest Neighbor, Natural Language Processing, Machine Learning, Resume Analysis, Skill Gap Analysis, Career Recommendation.

I. INTRODUCTION

Career selection is one of the most important decisions in a student's academic and professional journey. With the rapid evolution of technology and the emergence of new job roles, students often face difficulties in identifying career opportunities that align with their skills, interests, and long-term goals. Many students rely on informal guidance from peers, family members, or online resources, which may not always provide accurate or personalized recommendations. Modern career guidance systems aim to address these challenges by utilizing artificial intelligence and machine learning techniques to support informed decision-making. Research has demonstrated that AI-driven career recommendation systems can improve personalization, scalability, and recommendation quality when compared to conventional counseling approaches.

Recent studies have explored the application of machine learning algorithms, educational data mining, and behavioral analysis to support career planning and recommendation. Career recommendation models based on educational and personality data have shown promising results in helping students select suitable specializations and professional roles. Similarly, behavioral analysis and machine learning techniques have been employed to improve career prediction by considering multiple factors such as academic performance, interests, and personality characteristics.

Despite these advancements, many existing systems focus primarily on career prediction and do not provide comprehensive placement-oriented guidance. Students often require additional support in resume preparation, skill-gap identification, interview readiness, and placement preparation. Furthermore, many recommendation systems lack mechanisms to analyze unstructured textual data such as resumes and project descriptions, limiting their ability to provide personalized improvement suggestions.

To overcome these limitations, this paper proposes an Intelligent Career Guidance and Placement Recommendation System that combines K-Nearest Neighbor (KNN) and

Natural Language Processing (NLP). The KNN algorithm is used to recommend suitable career domains by analyzing similarities among student profiles, while NLP techniques are employed to extract skills from resumes, identify missing competencies, and evaluate placement readiness. The integration of these approaches enables a more comprehensive and personalized career guidance framework.

The major contributions of this work are as follows:

1. Development of a KNN-based career recommendation model for engineering students.
2. Implementation of an NLP-based resume analysis module for automated skill extraction.
3. Design of a skill-gap analysis framework to identify missing competencies.
4. Integration of placement readiness assessment and interview evaluation features.
5. Provision of personalized recommendations for career development and employability enhancement.

The proposed system is designed to support students in making informed career decisions while simultaneously improving their readiness for campus placements and industry recruitment processes. By combining machine learning and NLP techniques, the system seeks to bridge the gap between academic education and industry expectations and contribute to improved employment outcomes.

II. LITERATURE SURVEY

Career guidance and placement support systems have gained significant attention due to the growing complexity of modern career opportunities and the increasing demand for skilled professionals. Several researchers have explored the application of Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) to provide personalized career recommendations and placement assistance.

In the study *Skill Mentor: AI-Driven Student Skill Enhancement and Placement Prediction Framework*, the authors proposed an AI-based framework that predicts placement opportunities and identifies skill deficiencies among students. The system focuses on improving employability through skill enhancement and personalized recommendations [1]. Although the framework effectively predicts placement possibilities, it does not incorporate detailed resume analysis or comprehensive career-domain recommendations.

Research on machine learning-based career recommendation systems has demonstrated the effectiveness of classification algorithms in identifying suitable career paths. Such systems analyze student interests, academic performance, and technical skills to recommend relevant professions [2]. However, many existing approaches primarily focus on career prediction and provide limited support for placement preparation.

Recent advancements in NLP have enabled automated resume screening and skill extraction. NLP-based systems can analyze resume content, identify relevant skills, and compare candidate profiles with job requirements [3]. These techniques reduce manual evaluation efforts and improve recruitment efficiency. Nevertheless, most resume screening systems are designed for recruiters rather than students seeking career guidance.

Skill-gap analysis frameworks have also been proposed to bridge the gap between academic learning and industry requirements. These systems compare existing competencies with desired job skills and provide recommendations for improvement [4]. While effective in identifying deficiencies, they often operate independently from career recommendation modules.

AI-driven interview assessment systems represent another emerging area of research. These systems evaluate candidate responses using NLP techniques and generate feedback based on communication skills, technical knowledge, and confidence levels [5]. Although useful for placement preparation, they are generally not integrated with career guidance frameworks.

The literature review indicates that existing systems address individual aspects of career development such as recommendation, resume screening, skill-gap analysis, or interview assessment. However, there is a lack of a unified platform that combines all these functionalities into a single intelligent system. Therefore, the proposed Career Guidance and Placement System integrates KNN-based career recommendation and NLP-based resume analysis with skill-gap identification and interview assessment to provide comprehensive career support.

III. METHODOLOGY

The proposed Career Guidance and Placement System aims to assist students in identifying suitable career opportunities and improving placement readiness through intelligent analysis and personalized recommendations. The system integrates the K-Nearest Neighbor (KNN) algorithm and Natural Language Processing (NLP) techniques to analyze both structured and unstructured student information. The framework processes academic records, technical skills, certifications, project experience, career interests, and resume content to generate personalized career recommendations and placement guidance.

A. System Overview

The proposed framework consists of multiple interconnected modules that collectively support career recommendation and placement preparation. Initially, student information is collected through a structured interface. The collected data undergoes preprocessing to remove inconsistencies and prepare it for analysis. The processed information is then evaluated using the KNN algorithm to determine suitable career domains. Simultaneously, NLP techniques are applied to analyze resume content and extract relevant technical

skills. The outputs from these modules are utilized to identify skill gaps, evaluate placement readiness, and generate personalized recommendations for career development.

B. Data Collection and Preprocessing

The effectiveness of the recommendation system depends on the quality of the input data. Therefore, the system collects comprehensive student information, including academic performance, technical skills, certifications, project experience, career interests, and placement preparation status. The collected information is subjected to preprocessing operations to improve consistency and reliability.

The preprocessing stage includes data cleaning, normalization, feature selection, and text processing. Missing values are handled appropriately, while textual data extracted from resumes is processed using tokenization, stop-word removal, and keyword extraction techniques. These operations ensure that the data is suitable for machine learning and NLP-based analysis.

C. Career Recommendation Using KNN

Career recommendation is performed using the K-Nearest Neighbor (KNN) algorithm, which classifies students into suitable career domains based on profile similarity. The algorithm compares the profile of a target student with previously stored career profiles and identifies the nearest neighbors using Euclidean distance as a similarity measure.

The Euclidean distance is calculated using:

$$d(x, y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

where $x$represents the target student profile, $y$represents a training profile, and $n$denotes the total number of features considered for comparison.

After computing the distance values, the algorithm selects the nearest neighboring profiles and determines the most suitable career category through majority voting. Based on the similarity analysis, the system recommends career domains such as Software Development, Data Science, Machine Learning, Cybersecurity, Cloud Computing, Full-Stack Development, and DevOps Engineering.

D. Resume Analysis Using NLP

The resume analysis module employs Natural Language Processing techniques to evaluate unstructured resume data. The uploaded resume is first converted into machine-readable text and then processed using NLP operations such as tokenization, stop-word removal, keyword extraction, and skill identification.

The extracted information is compared against predefined industry requirements associated with various career domains. The system evaluates the presence of technical skills, certifications, projects, and relevant achievements to determine resume quality and profile completeness. The results of this analysis contribute to both career recommendation and placement readiness assessment.

E. Skill Gap Analysis

The skill gap analysis module identifies discrepancies between a student's current competencies and the skills expected by industry for a recommended career path. The extracted resume skills are compared against predefined skill requirements associated with each career domain. Based on this comparison, the system identifies missing competencies and generates recommendations for improvement.

The generated report highlights areas requiring enhancement and provides guidance regarding certifications, training programs, projects, and learning resources. This process enables students to systematically strengthen their technical profile and improve their employability.

F. Placement Readiness Assessment

The placement readiness assessment module evaluates a student's preparedness for recruitment processes by considering multiple performance indicators. Factors such as technical proficiency, project experience, resume quality, communication ability, and interview performance are analyzed to generate an overall readiness score.

Based on the calculated score, students are categorized into different readiness levels. The assessment helps students understand their strengths and weaknesses while providing actionable suggestions to improve their chances of securing employment opportunities.

G. Personalized Recommendation Engine

The final stage of the proposed framework integrates the outputs generated by the career recommendation, resume analysis, skill gap analysis, and placement readiness modules. Using this information, the recommendation engine generates personalized guidance tailored to individual student profiles.

The generated recommendations may include suitable career domains, skill development plans, certification pathways, placement preparation strategies, and interview improvement suggestions. Through these personalized recommendations, the system supports students in making informed career decisions and enhancing their overall employability.

The integration of KNN and NLP within a unified framework provides a comprehensive solution for career guidance and placement support. By combining recommendation, analysis, assessment, and improvement mechanisms, the proposed system addresses the limitations of traditional career counseling approaches and offers a scalable, data-driven alternative for modern educational environments.

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IV. SYSTEM ARCHITECTURE

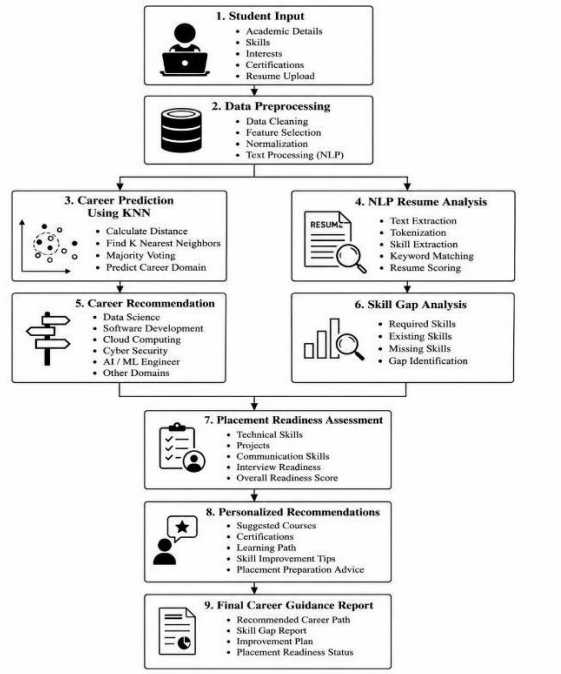
The proposed Career Guidance and Placement System is designed as an integrated platform that combines machine learning and natural language processing techniques to assist students in career planning and placement preparation. The

system processes both structured and unstructured data to generate personalized recommendations.

The architecture consists of six major modules:

1. Student Profile Management Module
2. Data Preprocessing Module
3. Career Recommendation Module
4. Resume Analysis Module
5. Skill Gap Analysis Module
6. Placement Readiness Assessment Module

System Workflow



The Student Profile Module collects information such as academic performance, technical skills, certifications, project experience, interests, and career preferences. The Data Preprocessing Module cleans and standardizes the collected data before analysis.

The KNN module identifies suitable career domains by comparing student profiles with predefined career datasets. Simultaneously, the NLP module extracts technical skills and keywords from resumes to evaluate employability. The Skill Gap Analysis module identifies missing competencies, while the Placement Assessment module evaluates overall readiness for recruitment processes.

The final recommendation engine integrates outputs from all modules to generate actionable guidance for students.

V. KNN-BASED CAREER RECOMMENDATION

The K-Nearest Neighbor (KNN) algorithm is one of the most widely used supervised machine learning algorithms for classification tasks. In the proposed system, KNN is used to recommend suitable career paths based on student profile similarity.

The recommendation process begins by collecting various attributes from students, including:

- Academic performance
- Programming skills
- Technical certifications
- Project experience
- Areas of interest
- Technical competencies

Each student profile is represented as a feature vector. The KNN algorithm calculates the similarity between the target student and existing career profiles using Euclidean Distance.

Algorithm

Input: Student Profile Dataset
Output: Recommended Career Domain
Step 1: Collect student profile attributes.
Step 2: Normalize feature values.
Step 3: Calculate Euclidean distance between the target profile and all training profiles.
Step 4: Sort profiles according to distance.
Step 5: Select K nearest neighbors.
Step 6: Determine the majority career category.
Step 7: Generate career recommendation.

Career Categories

The system recommends careers such as:

- Software Developer
- Data Scientist
- Machine Learning Engineer
- Cybersecurity Analyst
- Cloud Engineer
- Full Stack Developer
- DevOps Engineer

The KNN algorithm is selected because of its simplicity, effectiveness, and ability to provide personalized recommendations based on similarity analysis.

VI. NLP-BASED RESUME ANALYSIS

Natural Language Processing (NLP) is employed to analyze unstructured resume data and extract meaningful information regarding a student's technical competencies. The uploaded resume is first converted into machine-readable text format and then processed through a sequence of text preprocessing operations including tokenization, stop-word removal, stemming, and keyword extraction. The extracted keywords are mapped to predefined skill categories to identify the student's strengths and areas requiring improvement.

The NLP module evaluates technical skills, certifications, project experience, and relevant achievements. The extracted

information is compared with industry requirements associated with the recommended career domain. Based on this comparison, the system generates a resume score and provides suggestions for enhancing profile quality and placement readiness. The automated resume analysis process reduces manual evaluation effort while ensuring objective assessment of student competencies.

Placement Readiness Assessment

The placement readiness assessment module evaluates the overall preparedness of students for recruitment processes. The assessment is based on multiple parameters including technical proficiency, project experience, resume quality, communication ability, and interview performance. Each parameter contributes to an overall readiness score that reflects the student's employability level. Based on the calculated score, students are categorized into different readiness levels and receive personalized recommendations for improvement. This module enables students to understand their current standing and take corrective actions before participating in placement activities.

Results Table

Module	Functionality Achieved
Career Recommendation	Career domain prediction using KNN
Resume Analysis	Skill extraction using NLP
Skill Gap Analysis	Identification of missing skills
Placement Assessment	Employability evaluation
Recommendation Engine	Personalized career guidance

Table 1. Functional Evaluation of the Proposed System

VII. RESULTS AND DISCUSSION

The developed Career Guidance and Placement System successfully integrates machine learning and NLP techniques to provide personalized career guidance and placement support.

The KNN module effectively classifies student profiles into relevant career domains based on skill similarity and academic attributes. Students receive recommendations aligned with their technical competencies and interests.

The NLP module successfully extracts technical skills and relevant keywords from uploaded resumes. Resume evaluation helps identify strengths and weaknesses in student profiles.

The Skill Gap Analysis module identifies missing competencies and provides recommendations for skill enhancement. This functionality helps students understand industry requirements and focus on improving specific skills.

The Placement Readiness Assessment module evaluates overall employability based on multiple factors including:

- Technical knowledge
- Resume quality
- Project experience
- Communication skills
- Interview readiness

Functional Evaluation

Module	Status
Student Registration	Successful
Career Recommendation	Successful
Resume Analysis	Successful
Skill Gap Analysis	Successful
Placement Assessment	Successful
Recommendation Generation	Successful

Table 2. Functional Evaluation

Discussion

The integration of KNN and NLP enables comprehensive career support beyond traditional recommendation systems. Unlike existing solutions that focus solely on career prediction, the proposed framework combines recommendation, resume analysis, skill assessment, and placement readiness evaluation within a unified platform.

The system can significantly reduce dependency on manual counseling while providing data-driven insights for students. Furthermore, the modular architecture allows future enhancements such as deep learning-based recommendation models, chatbot integration, and real-time industry trend analysis.

VIII. CONCLUSION AND FUTURE WORK

Selecting an appropriate career path and preparing for placement opportunities remain major challenges for engineering students. This paper presented an Intelligent Career Guidance and Placement System that integrates K-Nearest Neighbor (KNN) and Natural Language Processing (NLP) techniques to provide personalized career recommendations and placement support.

The KNN algorithm was utilized to identify suitable career domains based on student profile similarity, while NLP techniques were employed for resume analysis, skill extraction, and skill-gap identification. The proposed system also incorporated placement readiness assessment and personalized recommendation generation to support career development.

The developed framework provides students with valuable insights into their strengths, weaknesses, and career opportunities. By bridging the gap between academic learning and industry expectations, the system contributes to improved employability and informed career decision-making.

Future Work

Future enhancements may include:

- Integration of Deep Learning algorithms.
- Real-time job recommendation systems.
- AI-powered career counseling chatbots.
- Personality-based career assessment.
- Industry trend prediction using data analytics.
- Advanced interview simulation using Generative AI.
- Integration with professional networking platforms.

The proposed system demonstrates the potential of combining machine learning and natural language processing for intelligent career guidance and placement support.

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