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Predictive Analysis Using Artificial Intelligence to Measure Employability Potential of Engineering Graduates Based on Academic and Behavioral Data

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***Abstract*—The employability of engineering graduates has become a critical concern in today's competitive job market, where organizations seek candidates who possess not only technical expertise but also essential behavioral and soft skills. Traditional evaluation methods that focus mainly on academic performance often fail to provide a complete picture of a student's job readiness. This study proposes an Artificial Intelligence (AI)-based predictive analytics framework to assess the employability potential of engineering graduates by integrating academic and behavioral data. Academic variables include CGPA, subject performance, attendance, backlogs, certifications, projects, internships, and technical-skill assessments, while behavioral variables include communication skills, teamwork, leadership, problem-solving, participation in extracurricular activities, adaptability, and interview performance. Machine learning algorithms such as Random Forest, Logistic Regression, and Neural Networks will be employed to build and validate predictive models that classify students by employability potential and highlight the key factors affecting job readiness. The proposed model aims to help educational institutions understand the strengths and weaknesses of their students and design targeted training and skill development programs, while providing students with personalized insights to enhance their employability prospects. Overall, this study contributes to bridging the gap between academic learning and industry expectations through data-driven employability assessment.**

***Index Terms*—Artificial intelligence, behavioral data, educational data mining, employability, engineering graduates, explainable AI, machine learning, predictive analytics, student placement.**

I. INTRODUCTION

In the modern employment landscape, the demand for highly skilled and adaptable engineering graduates is greater than ever. While technical knowledge and academic performance have traditionally been used as key indicators of employability, industries now place equal emphasis on behavioral traits such as communication, teamwork, leadership, and problem-solving abilities. However, many engineering graduates still face difficulties securing suitable employment due to the lack of a holistic assessment that combines both academic and behavioral competencies.

With rapid advancements in Artificial Intelligence (AI) and data analytics, it has become possible to analyze large and diverse datasets to uncover patterns that can predict outcomes such as employability. Predictive analysis uses AI and machine learning techniques to process and interpret data, identify key influencing factors, and forecast potential future results. Applying this approach to measure employability can provide valuable insights into how academic performance, behavioral traits, and personal development contribute to job readiness.

This study focuses on developing an AI-based predictive model that evaluates the employability potential of engineering graduates using academic and behavioral parameters. By integrating data from various sources such as grades, attendance, project performance, communication skills, leadership activities, and participation in extracurricular events, the system can generate a comprehensive employability score or classification. Such an approach helps educational institutions understand the preparedness of their students for industry roles and identify areas that require improvement.

Furthermore, the insights derived from this predictive model can assist in curriculum enhancement, targeted training programs, and personalized career guidance. Students can gain awareness of their strengths and weaknesses, while institutions can make data-driven decisions to bridge the gap between academic learning and industry expectations. Ultimately, this AI-driven framework aims to create a more effective and fair assessment system that improves employability outcomes for engineering graduates.

II. OBJECTIVES

A. Primary Objective

To develop an AI/ML framework that predicts the employability potential of engineering graduates.

B. Secondary Objectives

1) To develop a predictive model using Artificial Intelligence (AI) that can evaluate and forecast the employability potential of engineering graduates based on multiple parameters.
2) To collect, organize, and analyze academic and behavioral data of students, including grades, technical performance, communication skills, teamwork, and participation in extracurricular activities.
3) To identify the key academic and behavioral factors that have the greatest influence on a student's employability outcomes.
4) To integrate machine learning algorithms for training and testing the predictive model to ensure accurate and reliable employability predictions.
5) To design a data-driven framework that helps educational institutions assess students' readiness for the job market in a more comprehensive and objective manner.

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6) To provide actionable insights and recommendations for students to improve their employability skills through targeted training and personality development programs.
7) To assist academic institutions and placement departments in monitoring employability trends and improving curriculum design based on predictive analysis results.
8) To create a visual representation or dashboard that displays employability scores, strengths, weaknesses, and overall readiness of graduates.
9) To identify individual students' skill gaps.

III. METHODOLOGY

The proposed study follows a systematic approach that combines data collection, preprocessing, model development, and performance evaluation to predict the employability potential of engineering graduates using AI techniques. The methodology is outlined in the following steps.

A. Data Collection

Data will be collected from various academic and behavioral sources, namely student records, surveys, and institutional databases.

- Academic data: CGPA, semester marks, attendance records, project grades, and technical skill assessments.
- Behavioral data: soft skills, communication ability, teamwork participation, leadership qualities, extracurricular involvement, and internship evaluations.

B. Data Preprocessing

Before applying AI models, the data must be cleaned and standardized to ensure accuracy and consistency. This step ensures the dataset is suitable for analysis and machine learning model training. It includes:

- handling missing or incomplete values;
- removing duplicate or irrelevant data;
- converting categorical variables into numerical formats using encoding methods; and
- normalizing or scaling data for better model performance.

C. Feature Selection and Extraction

Feature selection techniques will be used to identify the most influential academic and behavioral attributes that affect employability. Techniques such as Correlation Analysis, Principal Component Analysis (PCA), or Information Gain may be applied to reduce dimensionality and improve the efficiency of the model.

D. Model Development

Machine learning algorithms will be implemented to build predictive models capable of forecasting employability potential. The candidate algorithms are:

- Logistic Regression for binary classification (employable/not employable);
- Random Forest for identifying key predictive features and handling complex data patterns;
- Support Vector Machine (SVM) for high-dimensional classification tasks; and
- Artificial Neural Networks (ANN) for advanced pattern recognition and non-linear relationships.

The data will be divided into training and testing sets to evaluate the accuracy and generalization of the model.

E. Model Evaluation

The developed model will be assessed using performance metrics such as accuracy, precision, recall, F1-score, and the ROC-AUC curve. These metrics will help determine how well the AI system predicts employability outcomes.

F. Visualization and Interpretation

Results will be visualized through graphs, charts, and dashboards using tools such as Python (Matplotlib, Seaborn) or Tableau/Power BI. The visualization will display employability scores, key influencing features, and overall readiness levels of graduates.

G. Implementation and Validation

Finally, the predictive system will be tested on real student datasets to validate its performance. Feedback from academic experts and placement officers will be used to refine the model for practical implementation.

H. Outcome Utilization

The insights obtained from the model can help:

- students identify areas for personal and professional improvement;
- institutions design training programs to enhance employability; and
- recruiters pre-assess candidates' potential objectively.

IV. RESEARCH QUESTIONS

RQ1: Which academic factors significantly influence the employability potential of engineering graduates?

RQ2: Which behavioral factors significantly influence employability?

RQ3: Does combining academic and behavioral data improve predictive performance compared with academic data alone?

RQ4: Which machine-learning algorithm provides the best predictive performance?

RQ5: Can Explainable AI identify the major factors responsible for an individual employability prediction?

RQ6: Does the predictive system demonstrate acceptable levels of fairness across relevant demographic groups?

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