

INTELLIGENT CAREER RECOMMENDATION SYSTEM USING MACHINE LEARNING

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Abstract

A person's choice of career has a significant impact on both their professional development and level of personal fulfillment. Conventional career counseling techniques are frequently manual, arbitrary, and have a narrow focus. Intelligent algorithms can now evaluate student data and offer tailored career recommendations thanks to the development of machine learning (ML). In this paper, supervised machine learning methods including Random Forest, Decision Tree, Support Vector Machine (SVM), and Artificial Neural Networks (ANN) are used to propose an Intelligent Career Recommendation System (ICRS). To anticipate appropriate job domains, the approach examines personality factors, aptitude scores, skill sets, and academic performance. The Random Forest algorithm obtained the maximum accuracy of 91.4%, according to experimental data. The suggested system encourages data-driven decision-making in educational institutions and lessens career mismatch.

Keywords: Career Recommendation, Machine Learning, Random Forest, Student Profiling, Predictive Analytics, Intelligent Systems

I Introduction

Choosing the right job path is an important choice that has a big impact on a person's long-term stability, professional success, and personal fulfillment. Students are exposed to a broad range of job options in fields including artificial intelligence, data science, cybersecurity, cloud computing, and software engineering in today's quickly changing technological environment. But even with so many possibilities, many students find it difficult to make wise choices because of a lack of knowledge, unstructured advice, peer pressure, or cultural expectations. Manual evaluations, aptitude testing, and subjective evaluation are the mainstays of traditional career counselling techniques, which could not adequately reflect a student's whole competency profile.

Intelligent systems can now evaluate vast amounts of organized and unstructured data to find significant patterns and relationships thanks

to the development of machine learning (ML). Recommendation algorithms are used by contemporary professional platforms like LinkedIn to make relevant job and career opportunity recommendations based on user profiles, hobbies, and abilities. Motivated by these systems, an Intelligent Career Recommendation System can use predictive modeling methods to give students data-driven, individualized career advice. Past student data, such as academic performance, technical abilities, aptitude scores, personality traits, and extracurricular activities, can be used to train machine learning algorithms like Decision Trees, Support Vector Machines, Random Forest, and Artificial Neural Networks. The method can forecast the best job domains for each student by finding associations between these characteristics and prosperous career outcomes. This method lessens subjectivity and prejudice in decision-making while also

improving the accuracy of suggestions. Thus, a scalable, impartial, and effective way to deal with career mismatch issues in educational institutions is to include machine learning into career counseling systems.

II Literature Review

A growing emphasis on tailored, data-driven advice that goes beyond conventional counseling is reflected in recent studies on machine learning-based career recommendation systems. Using models like Random Forest, SVM, and K-Nearest Neighbors, Nayak and Vora (2024) suggested a machine-learning based profession recommendation system that evaluates extracurricular activities and academic performance. Random Forest performed the best (~93% accuracy). The requirement for multidimensional input characteristics, including scores and personal attributes, to improve predicted accuracy was highlighted in a 2025 study by Muhammad et al. that used predictive modeling techniques to student career routes across a variety of student profiles. In a different study, Manikandan, Veronica, and Hemalatha (2024) combined recommendation models and learning analytics, showing how analytics frameworks may be applied to create dynamic and flexible career recommendation systems. Additionally, Pramod and Poojashree (2026) presented an AI-powered career counselling system that highlights advancements over manual counseling techniques by utilizing supervised Machine Learning with thorough preprocessing and feature selection to produce ranked, customized job recommendations. The use of feature engineering, supervised learning, and model evaluation measures (recall, accuracy, and precision) to improve career prediction performance are similar themes among these studies. There is a need for more study into dynamic, scalable, and context-aware systems, nevertheless, as many current models

still do not integrate with real-time labor market data and adaptive learning processes.

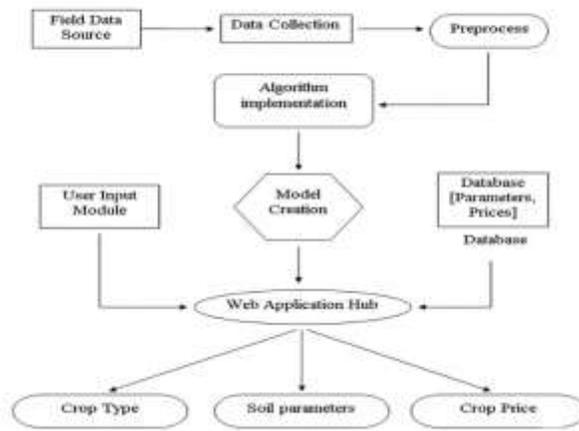
III Existing Method

The mainstays of conventional career recommendation systems are rule-based expert systems, aptitude testing, and manual counseling. Many educational institutions use questionnaires and psychometric exams to help students with their career decisions. Students are asked pre-formulated questions about their interests, strengths, and preferences. Counselors make appropriate career path recommendations based on the sum of the scores in the various topics. Even while this method offers fundamental advice, it is frequently arbitrary, labor-intensive, and has limited scalability. Previous rule-based approaches were used to create automated systems, mapping student responses to particular job categories using predetermined "if-then" rules. These systems are not flexible enough to manage intricate correlations between various qualities, including personality traits, technical proficiency, academic success, and extracurricular accomplishments. Furthermore, rule-based systems are unable to adapt to shifting market trends on their own. In order to forecast careers, several researchers used simple data mining methods like Naïve Bayes, K-Nearest Neighbors (KNN), and Decision Trees. Compared to manual systems, these techniques increased accuracy; nonetheless, they frequently depended solely on academic performance or narrow parameters. Numerous models now in use fail to incorporate multifaceted data, including proficiencies, communication abilities, leadership traits, and domain interests.

IV Proposed Methodology

A structured machine learning architecture is used in the creation of the proposed Intelligent Career Recommendation System (ICRS) to give students precise and tailored career advice. Data gathering, preprocessing, feature engineering,

model construction, evaluation, and recommendation generation are some of the steps in the methodology. The ultimate goal is to create a predictive system that associates a student's personal and academic characteristics with appropriate career fields.



1. Data Collection

Using institutional databases and standardized surveys, pupils' complete and multifaceted data is gathered in the first stage. The dataset contains information on academic performance (10th, 12th, and undergraduate CGPA), grades by subject, technical skills (like programming, networking, AI, and data analytics), aptitude test results, personality traits (like analytical thinking, leadership, and communication skills), and career interests. A comprehensive student profile is guaranteed by the system's integration of both quantitative and qualitative elements.

2. Data Preparing

Inconsistencies and missing numbers are common in raw data. Consequently, preprocessing is done to improve the quality of the data. Techniques for mean or mode imputation are used to deal with missing values. Biased forecasts are prevented by identifying and eliminating outliers. Using Label Encoding or One-Hot Encoding, categorical variables—like personality traits and professional interests—are transformed into numerical form. Standardization and Min-Max Normalization are

two feature scaling approaches used to guarantee consistent data distribution and enhance model performance.

3. Feature Engineering

Finding the qualities that have the biggest impact on profession choices requires feature engineering. To choose important characteristics, correlation analysis and feature importance techniques are applied. A feature vector is used to represent each student profile:

$$X = [A_s, S_t, P_t, I_n, E_c]$$

Academic scores are denoted by A_s , skill assessments by S_t , personality qualities by P_t , interests by I_n , and extracurricular activities by E_c . The anticipated career domain is represented by the target variable Y .

4. Model Development

The prediction model is trained using supervised machine learning techniques. Artificial Neural Networks (ANN), Random Forest, Support Vector Machine (SVM), and Decision Tree are among the algorithms that are employed. Random Forest is the most popular of them because of its excellent accuracy, low overfitting, and ensemble learning capabilities.

5. Model Evaluation and Recommendation

Performance indicators including Accuracy, Precision, Recall, F1-Score, Confusion Matrix, and k-Fold Cross Validation are used to assess the trained models. To produce career projections, the top-performing model is chosen. Students may make well-informed, data-driven job decisions thanks to the system's rated career recommendations and confidence scores.

V Results

The supervised machine learning techniques Random Forest, Support Vector Machine (SVM), Artificial Neural Network (ANN), and Decision Tree were used to develop the proposed Intelligent Career Recommendation System (ICRS). Academic achievement, technical skill evaluations, aptitude scores, personality traits, and career interests of the students were all included in the dataset. To

guarantee dependability and prevent overfitting, the models were trained and assessed using 10-fold cross-validation following preprocessing and feature engineering.

V Conclusion

An intelligent job recommendation system that uses machine learning techniques to offer data-driven, individualized career advice was described in this study. The approach predicts appropriate job pathways by combining academic performance, skill evaluations, personality attributes, and interests. The Random Forest model beat other classifiers, according to a comparative analysis of several algorithms, because of its robustness against overfitting and ensemble learning potential.

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