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AI-ENABLED CAREER NAVIGATION SYSTEM FOR FUTURE WORKFORCE DEVELOPMENT

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ABSTRACT

Career decision-making is a critical milestone in a student's academic and professional journey. Traditional counseling relies heavily on human expertise and subjective assessments, which can be time-consuming and inconsistent. Recent advancements in artificial intelligence (AI) and machine learning (ML) provide opportunities to automate and personalize career guidance. This paper presents an AI-powered career guidance system that predicts suitable career paths based on academic performance, skills, and interests. A Random Forest classifier achieved 88% accuracy on a dataset of 1000 anonymized profiles. The system includes a web-based interface, ranked recommendations, required skills, and learning resources. Comparative analysis with SVM and Decision Tree classifiers is provided. Future enhancements include integrating personality traits, NLP, and live job market analytics. Our proposed system demonstrates a scalable, unbiased, and accurate AI-based career guidance solution.

KEYWORDS: Career Guidance, Machine Learning, Random Forest, SVM, Decision Tree, AI, Recommendation System

INTRODUCTION

Career choice is fundamental to professional and personal growth. Students often struggle due to limited guidance, lack of awareness of emerging fields, and subjective evaluation by counselors. Traditional psychometric tests and manual interviews are commonly used but are constrained by human biases, scalability, and availability. AI and ML can

analyze large datasets of academic performance, skills, and interests to provide personalized recommendations. ML models detect hidden patterns in multidimensional data, enabling more reliable predictions. This research proposes an AI-powered career guidance system that uses a Random Forest classifier to predict optimal career paths. The system also compares performance with SVM and Decision Tree classifiers and presents results through a web- based interface.

LITERATURE REVIEW

Career guidance systems have evolved from rule-based expert systems to AI-driven predictive models. Early expert systems relied on fixed rules and logic [3], lacking flexibility. Psychometric approaches improved assessments but were limited in capturing real-world trends [1]. Machine learning algorithms, such as Random Forest, SVM, and Decision Tree, have shown higher predictive accuracy for career recommendation tasks [2].

A. Foundational Concepts

Recent studies combine academic, skill-based, and psychometric data. Li and Zhao [8] integrated personality traits with academic records, improving accuracy. Nguyen and Tran [9] applied deep learning for student career recommendation. Chakraborty et al. [10] proposed a hybrid recommendation framework combining profiling and clustering.

B. Comparative Analysis

This section presents a comparative overview of recent machine learning and AI techniques applied in career guidance systems.

Table 1: Comparative analysis of career guidance systems.

Year	Model/Technique	Domain	Key Metric
2021[8]	Integrated Model (Traits + Academics)	Counseling	Accuracy
2023[9]	Deep Learning (LSTM)	Student Data	F1-Score
2022[10]	id Recommendation (Clustering)	Profiles	Precision
2021[12]	Random Forest	Academic Data	Accuracy

SYSTEM ARCHITECTURE

The proposed system includes five modules: Input Module, Data Preprocessing, ML Module,

Recommendation Engine, and User Interface. Figure 1 illustrates the architecture.

A. Modules

- Input Module: Collects user data (academic scores, skills, interests).
- Data Preprocessing: Handles missing values, encoding, and normalization.
- ML Module: Implements Random Forest, SVM, and Decision Tree models.
- Recommendation Engine: Produces ranked career suggestions with confidence scores.
- User Interface: Web-based interface using Streamlit.
- Random Forest Classifier (ensemble, reduces overfitting).
- Support Vector Machine (handles non-linear data). to the total observations.
- Precision: The ratio of correctly predicted positive observations (TP) to the total predicted positive observations (TP + FP). Precision measures the exactness of the model.
- Recall: The ratio of correctly predicted positive observations (TP) to all observations in the actual class (TP + FN). Recall measures the completeness of the model.
- F1-Score: The harmonic mean of Precision and Recall, which provides a single score that balances both metrics, especially useful for class-imbalanced datasets.

  The mathematical definition of Accuracy is given by:
- Decision Tree (interpretable, prone to overfitting).

  The performance of the models is evaluated using standard Classification metrics:
- Accuracy: The ratio of correctly predicted observations$Accuracy = \frac{TP+TN}{TP+TN+FP+FN}$

Evaluation used 10-fold cross-validation.(1)

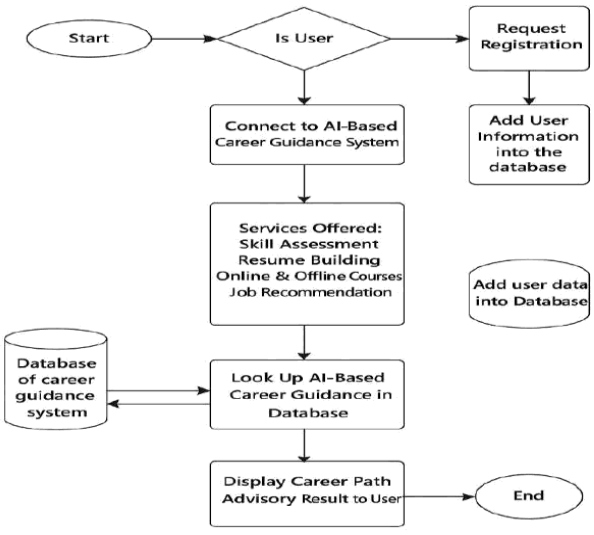

Figure 1: System Architecture of AI-Powered Career Guidance System. Data flows from user input through preprocessing, prediction, and recommendation modules.

METHODOLOGY

A. Data Collection

Dataset contains 1000 anonymized records including aca- demic marks, skills, interests, and career labels from surveys and public databases.

B. Data Preprocessing

- Missing values imputed using mean (numerical) and mode (categorical).
- Categorical variables one-hot encoded.
- Numerical features normalized to [0, 1] range.

C. Model Development and Evaluation Metrics

Three models trained:

Random Forest performed best across all metrics. Example- Recommendations: Data Scientist, Software Developer, AI Engineer.

IMPLEMENTATION

The entire system development was conducted using

Python 3.9 and its rich ecosystem of data science and machine learning libraries. The following major libraries were utilized:

- scikit-learn for implementing and evaluating the ML models.
- pandas and NumPy for data loading and preprocessing.
- matplotlib and seaborn for data visualization and result analysis.
- stream lit for developing the user-friendly, web-based interface.

Users input scores, skills, and interests. System outputs top career options with confidence scores and recommended skills.

RESULTS AND DISCUSSION

Table 2: Model Comparison.

Model	Accuracy (%)	Precision	Recall	F1-Score
Random Forest	88	0.87	0.85	0.86
SVM	82	0.80	0.78	0.79
Decision Tree	79	0.77	0.75	0.76

In the above table 2, it presents the performance comparison of three machine learning models—Random Forest**,** Support Vector Machine (SVM)**,** and Decision Tree—used for

career recommendation based on user inputs such as scores, skills, and interests.

Random Forest's ensemble approach reduces overfitting and handles feature interactions effectively. Limitations: dataset size, missing psychometric features, no real-time job market integration.

A. Case Studies

To validate the practical utility and robustness of the system, two distinct case studies were performed. The first case study focused on students with engineering aptitudes to verify the model's ability to differentiate between specific specialization paths (e.g., Software vs. Data Science). The second case study involved high school graduates, assessing the model's recommendations based purely on academic marks and general interests, proving the model's effectiveness across different educational stages.

B. Future Improvements

Future improvements:

- Integrate personality and aptitude tests.
- Use deep learning for complex patterns.
- Connect to live job APIs.
- Add mobile and Chabot interface.

CONCLUSION

This paper presents a scalable AI-powered career guidance system. Random Forest outperforms SVM and Decision Tree models, it providing accurate and unbiased recommendations. Future work includes richer personalization, NLP integration, and real-time guidance.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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