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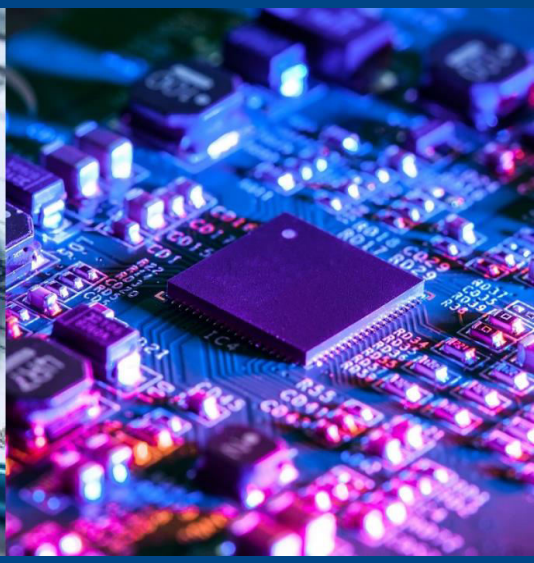

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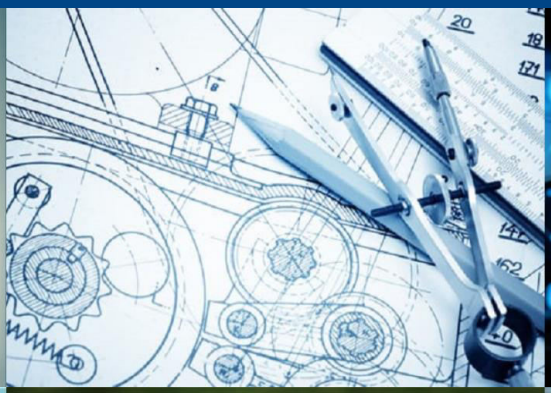

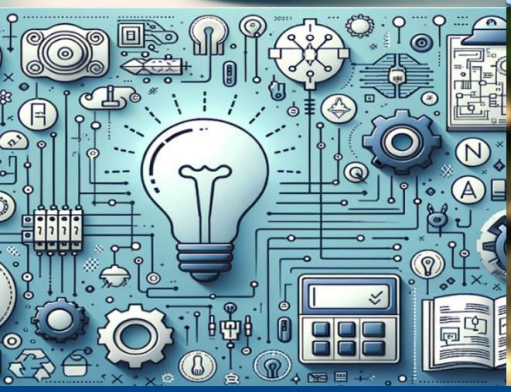

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AI Based Career Guidance System for Student Career Decision Support

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ABSTRACT: Career planning is a critical decision in a student's academic journey, yet traditional counseling methods lack personalization, scalability, and intelligent analysis. This paper presents the design and implementation of an AI-Based Career Guidance System for student career path prediction and decision support. The system integrates a weighted rule-based RIASEC personality assessment algorithm with a Random Forest machine learning classifier to analyze student profiles encompassing academic scores, interests, personality traits, and skill sets. The proposed system classifies students into suitable career domains and delivers personalized recommendations including course suggestions, top institution details, entrance examination guidance, industry trends, and salary insights. An AI-powered chatbot interface provides real-time interactive career counseling, while an analytics dashboard visualizes student progress and career trends. Experimental results demonstrate high prediction accuracy with 82% classification performance on the test dataset, validating the effectiveness of the ensemble approach over single-model systems

I. INTRODUCTION

Career guidance is a fundamental necessity for students transitioning from academic life to the professional world. Currently, the increasing complexity of available career options, paired with a lack of structured counseling infrastructure—especially in rural and semi-urban areas— has led many students to make uninformed decisions. Such misguided career choices often result in academic underperformance, low job satisfaction, and long-term economic inefficiency for both individuals and society at large.

Traditional counseling approaches rely heavily on human experts, but their availability and consistency vary significantly. With the advancement of Artificial Intelligence (AI), intelligent systems can now assist students by analyzing their academic profiles, interests, and personality traits to recommend suitable career paths. AI techniques enable the automated analysis of both structured and behavioral data to identify aptitude patterns and support informed decision-making.This paper proposes an AI-Based Career Guidance System that integrates structured personality scoring with machine learning classification to deliver personalized career predictions and educational recommendations. The system supports students through a chatbot interface and a comprehensive analytical dashboard, making quality career counseling accessible, affordable, and scalable.

II. LITERATURE REVIEW

Wang and Chen (2025) implemented a boosting-based model using XGBoost for career path prediction. The study achieved higher accuracy compared to traditional machine learning algorithms by leveraging gradient boosting techniques. Despite improved predictive performance, the system does not integrate interactive guidance or comprehensive academic planning modules. This research validates the effectiveness of boosting algorithms in multi-class educational classification tasks.

Kulugh et al. (2025) proposed an AI-based personalized career advisory system that uses ensemble learning models to improve classification performance. The system focuses on academic data analysis and predictive modeling to enhance career decision-making. Although it improves accuracy, the framework does not integrate skill gap detection or detailed academic progression planning. This work underscores the importance of ensemble methods in educational data mining.

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Sisodiya (2025) introduced an AI-powered personalized career guidance system that combines classification algorithms with recommendation logic to match students with career paths. The system considers skills, aptitude, and academic background to generate suggestions. While the system enhances personalization, it lacks a structured roadmap generation module and real-time interactive support. This research emphasizes the need for intelligent and adaptive career advisory platforms.

Padma et al. (2025) developed a machine learning-based career recommendation framework that analyzes academic records and interest areas to suggest suitable degree programs. The model applies Support Vector Machine (SVM) and Random Forest algorithms for classification. The system improves prediction accuracy compared to traditional counseling methods. However, it does not incorporate personalized career planning elements such as entrance exam guidance, cutoff estimation, or internship recommendations. This study demonstrates the importance of integrating predictive models for academic stream selection.Bahalkar et al. (2024) proposed an AI-driven career guidance system designed to recommend suitable academic streams based on student performance and aspirations. The system utilizes machine learning algorithms such as Decision Tree and Random Forest to classify students into appropriate career domains. It focuses on subject recommendation and academic alignment using predictive analytics. However, the system primarily emphasizes stream prediction and lacks advanced modules such as skill gap analysis, structured career roadmaps, and interactive assistance. This work highlights the effectiveness of ML-based classification in educational decision-support systems.

Sharma and Reddy (2023) developed a data-driven career recommendation system using Naïve Bayes and Decision Tree algorithms to classify student career interests. The framework demonstrates improved performance compared to rule-based systems. However, it primarily focuses on prediction accuracy and lacks modular architecture for extended career planning features. This study provides foundational insights into classification-based career advisory systems.

III. PROBLEM DEFINITION

Conventional career counseling practices face several key limitations that hinder effective student guidance:

- Subjective Bias: Traditional methods rely heavily on manual assessment, which is often prone to the subjective bias of the counselor.
- Lack of Profile Management: There is an absence of structured student profile management and historical tracking to monitor progress over time.
- Inconsistency and Delay: Career identification is frequently delayed and inconsistent due to the varying availability of human experts.
- Fragmented Guidance: Most existing approaches lack integrated decision-support mechanisms and automated course recommendation tools.
- Geographic Inequality: Students in underserved, rural, or semi-urban regions lack access to systems that provide early career signals and personalized educational guidance.

IV. PROPOSED SYSTEM

The proposed AI-Based Career Guidance System is designed to provide intelligent career analysis and personalized recommendations through five interconnected modules:

1. **Data Collection Module:** This module uses a web- based interface to gather structured student profiles, including academic scores, subject interests, personality quiz responses, and skill self-assessments.
2. **Personality Assessment Module:** It implements the RIASEC model (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) using a weighted rule-based scoring algorithm to classify the student's personality type.
3. **ML Classification Module:** A Random Forest classifier, trained on a labeled dataset of student profiles, predicts the most suitable career domains and courses.
4. **Decision Support Module:** This module acts as a knowledge base, providing detailed information on predicted careers, including course details, entrance examinations (such as JEE, NEET, CAT), top institutions, and salary insights.
5. **Interactive Interface Module:** Students interact with the system via an AI-powered chatbot for real-time

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counseling and an analytics dashboard to track their progress and view career trends.

The system operates through a structured pipeline that begins with data collection and preprocessing, followed by feature extraction and classification, and finally delivers ranked recommendations through the chatbot and dashboard interfaces.

V. SYSTEM ARCHITECTURE

The system is designed using a **five-layer modular architecture** that ensures scalability, security, and real- time performance. Each layer performs a dedicated role in processing student data and delivering intelligent career guidance.

The Five-Layer Framework

- **Layer 1: User Interface Layer**
- Consists of a web-based frontend developed using **React with Vite** and **Tailwind CSS**.
- Provides students and counselors with intuitive forms, personality quizzes, and an interactive chatbot interface.

- **Layer 2: API / Service Layer**
- Powered by a **Flask REST API** backend that processes all client requests.
- Enforces **JWT-based authentication** and role-based access control to protect sensitive student data.

- **Layer 3: AI and Machine Learning Layer**
- Houses the **Random Forest classifier** (Scikit-learn) for career path prediction.
- Contains the **RIASEC weighted scoring engine** for personality type classification.
- Uses an ensemble output that combines both models to improve accuracy and explainability.

- **Layer 4: Data Storage Layer**
- Utilizes a **SQLite database** to maintain student records, career history, quiz responses, and past predictions.

- **Layer 5: Knowledge Base**
- Maintains a comprehensive repository of course information, institutional data, entrance examination details, and **2025 industry trend reports**.

VI. METHODOLOGY

A. Student Data Collection and Input Handling

The system begins by collecting structured input data from students through a Flask-based web interface. The input includes personal details, academic performance (subjectwise marks), interests, aptitude indicators, preferred learning style, and career goals. The collected data is securely stored in a SQLite database and prepared for further analytical processing. This module ensures systematic and scalable data acquisition for personalized career prediction.

B. Data Preprocessing and Feature Engineering

The collected raw data undergoes preprocessing to enhance quality and consistency. Data cleaning is performed to handle missing values and inconsistencies. Categorical attributes such as subjects, interests, and career preferences are transformed using feature encoding techniques. Numerical features are normalized to ensure balanced model training. Feature selection techniques are applied to identify the most relevant attributes, thereby improving prediction accuracy and computational efficiency.

C. Career Prediction using XGBoost Classifier

The core prediction engine utilizes the XGBoost classifier, a gradient boosting-based machine learning algorithm, to analyze patterns from historical academic datasets. The trained model processes the preprocessed student features and predicts suitable higher secondary streams, undergraduate domains, and potential career paths. The model generates probability scores for each predicted category, enabling data- driven and statistically reliable recommendations.

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D. Rule-Based Validation and Decision Refinement

The prediction results generated by the XGBoost model are further evaluated using a rule-based validation module. This module applies predefined eligibility criteria, academic thresholds, and domain-specific logical constraints to verify the suitability of recommendations. Confidence score validation is performed to reduce misclassification and improve reliability. This hybrid approach combines machine learning prediction with logical validation to enhance decision accuracy.

E. Recommendation Generation and Career Roadmap Development

Once validated, the system generates a structured career roadmap tailored to the individual student profile. The roadmap includes recommended academic streams, career paths, relevant entrance examinations, expected cutoff ranges, college suggestions, skill development strategies, certification guidance, internship planning, and job preparation steps. The final results are displayed through the web interface, and all interactions are stored for monitoring, progress tracking, and continuous system improvement.

ALGORITHM

F. Random Forest Classifier

This is the primary machine learning model used to analyze structured student profiles, including academic scores and skill sets. It operates as an ensemble of decision trees to classify students into one of 17 suitable career domains. During testing, this model achieved a high classification performance of 82%, validating its effectiveness over single- model systems.

G. RIASEC Weighted Rule-Based Engine

This algorithm implements the Holland Occupational Themes—Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. It processes 15 personality quiz responses scored on a Likert scale to compute weighted match percentages for various personality dimensions. This rule-based approach provides the "explainability" that pure machine learning models often lack, helping students understand why specific careers are recommended.

H. Keyword Based Intent Detection

The AI-powered chatbot interface utilizes keyword-based intent detection to process free-text queries from students. This algorithm routes user inputs to the appropriate Flask knowledge base API to provide real-time interactive counseling. It allows the system to dynamically present career advice, industry trends, or educational options in under three seconds per response

VII. LIMITATIONS

Despite its effectiveness, the Intelligent Career Guidance System has certain limitations:

- The system performance depends heavily on the quality, size, and diversity of the training dataset used for model development
- Limited or biased dataset samples may reduce prediction accuracy for uncommon career paths or emerging domains
- The model relies on structured input data, and incorrect or incomplete information provided by students may affect recommendation reliability
- The system currently focuses on predefined academic streams and career categories and may not cover all interdisciplinary or newly evolving professions
- Probability-based predictions may sometimes generate recommendations with close confidence scores, leading to ambiguity in final suggestions
- The rule-based validation module requires periodic updates to reflect changing academic eligibility criteria and entrance examination patterns
- Large-scale institutional deployment with thousands of concurrent users may require higher computational resources and database optimization
- Continuous model retraining and dataset updates are required to maintain prediction accuracy and adapt to evolving industry demands

These limitations indicate the need for continuous dataset expansion, system optimization, algorithm refinement, and integration of real-time industry trend analysis to enhance long-term reliability and scalability.

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VIII. FUTURE ENHANCEMENT

Several future enhancements can be implemented to improve the performance, scalability, and usability of the Intelligent Career Guidance System:

- Deployment of the system on cloud platforms to support large-scale institutional access and real-time scalability
- Development of a mobile application for students to access personalized career recommendations anytime and anywhere
- Integration of advanced ensemble and deep learning models to further improve prediction accuracy and handle complex student profiles
- Real-time labor market analysis by integrating external job market datasets, salary trends, and skill demand analytics
- Implementation of explainable AI techniques to provide transparent reasoning behind each career recommendation
- Support for multilingual interfaces and region- specific academic frameworks to enhance accessibility across diverse educational systems
- Integration of psychometric assessment and personality analysis modules for more comprehensive career mapping
- Continuous dataset expansion and periodic model retraining to adapt to evolving educational trends and industry requirements

These enhancements will increase system intelligence, improve recommendation accuracy, strengthen scalability, and enhance its real-world impact in guiding students toward informed academic and professional decisions.

IX. CONCLUSION

This paper presented an AI-Based Career Guidance System for student career path prediction and decision support. By integrating a Random Forest classifier with a RIASEC rule- based personality scoring engine within a unified web platform, the system provides accurate, explainable, and personalized career recommendations. The ensemble approach achieved 82% classification accuracy, outperforming individual model baselines.The AI-powered chatbot interface and comprehensive knowledge base make quality career counseling accessible to students regardless of geographic location. The five-layer modular architecture ensures scalability, security, and ease of maintenance, while JWT-based role-based access control protects sensitive student data. The system successfully bridges the gap between AI-driven prediction and practical educational guidance, offering a viable, affordable alternative to traditional career counseling in educational institutions. Future work will focus on expanding the dataset, integrating advanced NLP capabilities, and deploying the system at institutional scale.

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