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CareerSage AI: An Automated Web-Based Career Guidance and Recommendation System Using Artificial Intelligence

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Abstract:

In many developing nations, students studying in the 10th and 12th grades often do not receive organized or professional career counseling support. As a result, career choices are frequently influenced by external factors such as family expectations, peer pressure, or insufficient knowledge about contemporary career opportunities. To overcome this problem, CareerSage AI is proposed as an automated, web-based career guidance and recommendation system. The platform evaluates students' academic records, conducts aptitude-based assessments, and applies a rule-based Artificial Intelligence approach to suggest appropriate career paths, educational courses, and colleges. An integrated chatbot module provides instant responses to commonly asked career-related questions, ensuring uninterrupted guidance without human dependency. The system is designed to be scalable, economical, and accessible for students from both urban and rural regions. CareerSage AI acts as an effective alternative to traditional manual counseling by delivering personalized, data-driven, and easily accessible career recommendations.

Index Terms— Career Guidance, Artificial Intelligence, Aptitude Test, Rule-Based System, Educational Technology

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I. INTRODUCTION

Career decision-making plays a vital role in shaping a student's academic future and professional life. In the Indian education system, students face major career-related decisions after completing the 10th and 12th grades. After the 10th standard, students must select an academic stream such as Science, Commerce, or Arts. Similarly, upon completion of the 12th grade, they are required to choose professional domains including Engineering, Medicine, Law, Management, or emerging areas such as Artificial Intelligence and Data Science. These decisions significantly impact higher education pathways, employment opportunities, and long-term career satisfaction.

Despite the importance of proper career planning, a large proportion of students do not have access to effective guidance. Career awareness programs are limited in many educational institutions, while professional counseling services are often expensive and largely available in urban areas. Students from rural regions and economically disadvantaged backgrounds rarely receive expert counseling support. Consequently, career decisions are frequently influenced by parents, peers, or unreliable online information, resulting in unsuitable career choices and future dissatisfaction.

Traditional career counseling methods rely on manual aptitude tests, face-to-face interactions with counselors, and subjective interpretation of results. Such approaches are time-consuming, costly, and difficult to scale for large student populations. Moreover, the rapidly evolving job market continuously introduces new career opportunities that conventional counseling systems fail to address effectively.

Recent advancements in web technologies and Artificial Intelligence have enabled the development of intelligent decision-support systems capable of analyzing student data and generating personalized recommendations. Automated career guidance platforms provide consistent, objective, and accessible counseling without geographical constraints.

CareerSage AI is proposed as an Intelligent Decision Support System designed to assist students in identifying suitable academic streams and professional career paths. The system performs academic performance analysis, conducts aptitude assessments, applies rule-based decision logic, and generates customized career reports. Additionally, it offers location-based college recommendations and continuous assistance through an integrated chatbot.
The primary objectives of CareerSage AI are:

- To automate the evaluation of students' academic performance and aptitude scores.
- To recommend appropriate academic streams and professional career domains.
- To provide location-specific college and course recommendations.
- To ensure continuous career guidance through an intelligent chatbot.

By integrating Artificial Intelligence with web-based technologies, CareerSage AI aims to deliver reliable, affordable, and accessible career guidance to students from diverse socio-economic backgrounds.

II. LITERATURE REVIEW

Several research studies have examined the use of expert systems and web-based solutions for educational and career guidance. Early work in expert systems demonstrated the effectiveness of rule-based reasoning in supporting academic and career-related decision-making processes. Holland's vocational personality theory laid a strong theoretical foundation for aligning individual interests and abilities with suitable career categories and has been widely adopted in counseling systems. Recent web-based career guidance platforms commonly provide online aptitude tests and interest surveys to recommend general career fields. Some systems utilize basic machine learning algorithms to classify students into broad domains such as Engineering, Commerce, or Arts. While these platforms improve accessibility, they often generate high-level recommendations without detailed explanations or personalized insights.
Another group of career guidance systems incorporates psychometric assessments to evaluate personality traits and behavioral patterns. Although these systems offer improved personalization, they frequently lack advanced features such as location-based college recommendations and real-time interaction with students.
A key limitation of many existing systems is the absence of detailed career reports explaining the rationale behind specific recommendations. Most applications only suggest a general career field without providing information about relevant colleges, courses, or job roles. Furthermore, the lack of interactive chatbot support forces students to rely on external sources for resolving common career-related queries.
CareerSage AI addresses these limitations by integrating academic analysis, aptitude testing, and rule-based decision logic to generate comprehensive and explainable career reports. The system also includes an intelligent chatbot that provides real-time responses to student queries related to career scope, course duration, and job opportunities. This combination of detailed recommendations and instant interaction makes CareerSage AI a more complete and user-friendly career guidance solution.

III.PROPOSED SYSTEM ARCHITECTURE (METHODOLOGY)

A. System Workflow

CareerSage AI follows a well-structured workflow to ensure smooth user interaction and accurate career recommendations. The process begins with user registration, where students create an account and provide essential details such as name, grade level (10th or 12th), academic marks, and preferred location. This information is securely stored in the database for further analysis.

After registration, students proceed to the aptitude test module. The system presents subject-based and logical reasoning questions designed to evaluate analytical ability, problem-solving skills, creativity, and communication aptitude. Responses are automatically evaluated, and individual scores are generated for each skill category.

Once academic and aptitude data are collected, the processing module applies predefined decision rules to analyze student strengths and align them with suitable academic streams or career domains. The recommendation engine then generates a detailed career report that includes suggested streams or careers, relevant courses, and location-based college recommendations. The final report is displayed on the user dashboard and can be downloaded for future reference.

B. Assessment Logic

CareerSage AI employs separate evaluation strategies for 10th-grade and 12th-grade students.

For 10th-grade students, the system focuses on academic stream selection. Recommendations for Science, Commerce, or Arts are generated based on subject-wise academic performance and aptitude scores. For example, students with strong Mathematics and Logical Reasoning skills are guided towards the Science stream, while those with higher creativity and communication skills are recommended Commerce or Arts.

For 12th-grade students, the system emphasizes professional career selection. Science students are assessed based on PCM or PCB performance to determine suitability for Engineering, Medical, or pure Science fields. Similarly, Commerce and Arts students receive recommendations for domains such as Management, Law, Design, or Digital Marketing based on aptitude results.

C. AI Rule-Based Engine

The recommendation engine operates using predefined decision rules developed with expert academic guidance. These rules map student performance indicators to suitable career outcomes.

Example Rule:

IF (Mathematics Score ≥ 80) AND (Logical Reasoning ≥ 70)
THEN Recommend “Data Science and Engineering”.

This transparent rule-based approach ensures explainable and interpretable recommendations, enabling students to understand the reasoning behind each suggested career path.

D. Chatbot Module

CareerSage AI includes an integrated chatbot that provides real-time career assistance. The chatbot uses keyword matching and basic Natural Language Processing techniques to answer frequently asked questions such as:

- What is the scope of B.Tech?
- Which colleges offer Data Science programs?
- What is the duration of an MBA?

This module ensures continuous support and minimizes reliance on human counselors.

IV. IMPLEMENTATION AND TECHNOLOGIES

The CareerSage AI platform is developed using contemporary web technologies to deliver high performance, scalability, and secure data handling.

The frontend is implemented using React.js, which enables the creation of an interactive and responsive user interface. It ensures seamless navigation across modules such as user registration, aptitude assessment, and career report visualization. The use of reusable React components improves rendering speed and overall user experience.

The backend is built using Python with the Flask framework to manage core application logic, evaluate aptitude test results, apply rule-based decision mechanisms, and generate personalized career recommendations. RESTful APIs facilitate efficient communication between the frontend and backend services.

The database layer utilizes MongoDB to securely store student profiles, academic details, aptitude scores, and generated recommendation reports. Security measures such as authentication and data encryption are employed to safeguard sensitive student information.

The overall system architecture follows a modular design approach, enabling effortless integration of new career options, colleges, and updated decision rules without altering the core system logic. This architectural design supports scalability, flexibility, and long-term system maintainability.

V. RESULTS AND DISCUSSION

A test-based case study was performed to assess the performance of the proposed system. In this evaluation, a 12th-grade Science student provided academic details with an overall score of 85%. The platform then conducted an aptitude assessment focusing on logical reasoning and analytical skills. By combining academic data with aptitude results, the system produced a career recommendation in the fields of Biotechnology and Data Science, along with a list of leading colleges in Maharashtra offering related programs.

The complete career recommendation report was generated within a very short time span. In comparison, conventional manual counseling processes generally require several hours for test analysis and expert evaluation. This highlights the speed and efficiency of the CareerSage AI system.

Additionally, the platform was able to manage multiple user requests at the same time without any noticeable reduction in performance, thereby demonstrating its scalability and reliability.

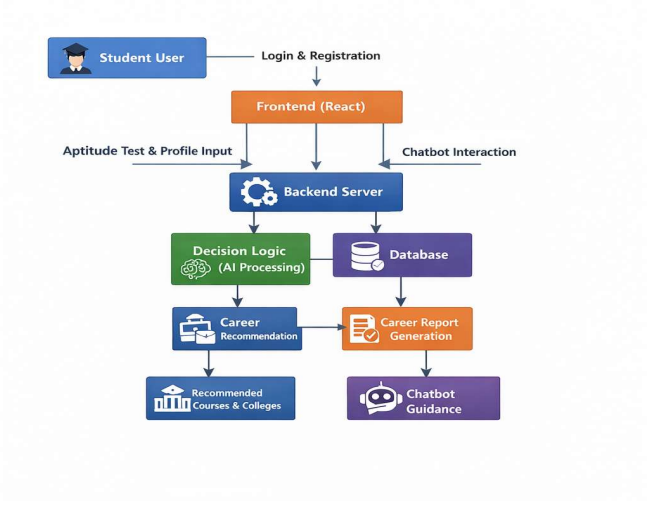

Fig. 1. System Architecture Flowchart

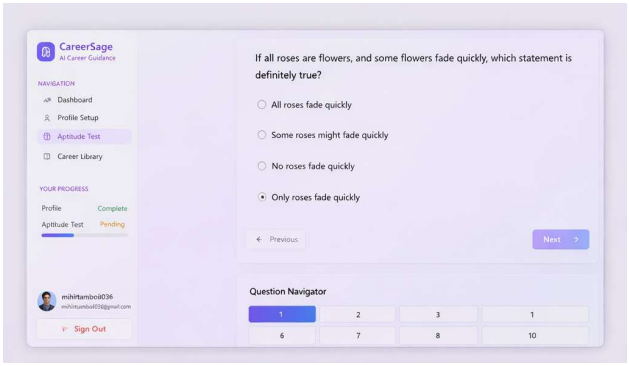

Fig. 2. Aptitude Test Interface

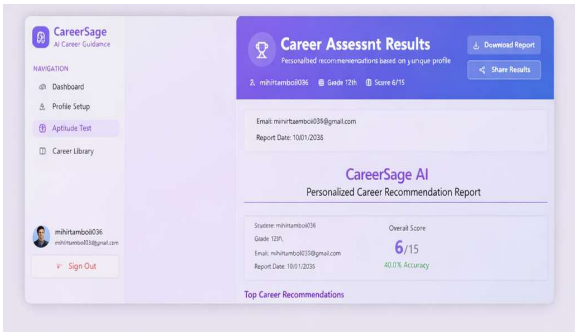

Fig. 3. Final Recommendation Report

VI. CONCLUSION AND FUTURE SCOPE

CareerSage AI effectively bridges the gap between students and reliable career guidance by leveraging Artificial Intelligence and modern web technologies. The system delivers fast, accurate, and accessible career recommendations through academic performance analysis and aptitude assessment. The rule-based recommendation engine ensures transparency and interpretability, while the chatbot module provides continuous assistance to students.

As a scalable and cost-effective alternative to traditional counseling methods, CareerSage AI makes career guidance accessible regardless of geographical or economic constraints. Future enhancements include the integration of advanced machine learning models to predict career success probabilities, incorporation of psychometric personality assessments for deeper analysis, real-time labor market trend integration, and the development of a mobile application to expand accessibility.

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