AI based career chatbot: Leveraging AI for Career Counseling

Menaka Gowda A[1], Krisha M[2],I Ashneel[3], G P Harshik[4]

[1] Student, Computer science and engineering ,BMS institute of technology, Karnataka, India
[2]Student, Computer science and engineering, BMS institute of technology, Karnataka, India
[3] Student, Computer science and engineering, BMS institute of technology, Karnataka, India
[4] Student, Computer science and engineering, BMS institute of technology, Karnataka, India

ABSTRACT

This research paper introduces a groundbreaking approach to personalized career counseling through the development and deployment of an innovative chatbot system. Built upon contemporary programming languages and advanced analytical methodologies, the chatbot offers users bespoke guidance derived from personality assessments, aptitude evaluations, and career recommendations. In contrast to conventional counseling paradigms, this chatbot harnesses cutting-edge algorithms to deliver scalable, user-friendly, and data-centric insights into academic and professional trajectories .The paper commences with an exploration of the prevailing landscape of career counseling, spotlighting the myriad challenges individuals encounter while navigating intricate educational and vocational choices. A thorough literature review follows, encompassing extant studies on chatbot-driven counseling solutions and machine learning models for career prognostication. Ethical considerations and data security implications relevant to AI-powered counseling platforms are also deliberated. Detailed insights into the chatbot's architecture and functionalities are provided, elucidating technical intricacies such as data manipulation, model integration, and interface design. Implementation specifics, including code excerpts and deployment strategies, illuminate the developmental journey and scalability of the chatbot. Evaluation outcomes and results delineate user feedback, usability assessments, and performance metrics for personality profiling and career forecasting. Illustrative case studies underscore the chatbot's efficacy in influencing users' decision-making processes and the potency of personalized recommendations. The paper culminates in a discourse on the ramifications of AI-driven personalized career counseling, emphasizing strengths, constraints, and future research trajectories. Proposals for further refinement, algorithmic enhancements, and feature augmentation underscore the chatbot's potential to redefine the contours of career counseling.

Keyword:- *Personalized career counselling, Chatbot system, Programming languages, Advanced analytical methodologies ,Personality assessments, Aptitude evaluations, Career recommendations, Machine learning models ,Data-centric insights ,Scalability ,User-friendly ,Data security ,Ethical considerations ,AI-powered counselling platforms, Interface design ,Usability assessments, Performance metrics, Personality profiling, Career forecasting, Decision-making processes.*

1. INTRODUCTION

In a rapidly evolving world, the importance of making informed career choices has never been greater. The transition from secondary education to the broader landscape of higher learning and professional life is a pivotal moment in every student's journey. Yet, for many secondary-level students, the process of career decision-making can be daunting, complex, and often filled with uncertainties.

This project seeks to bridge this gap by introducing an innovative solution that leverages the power of Artificial Intelligence (AI) to provide comprehensive and accessible career counselling to students at the secondary level. The heart of this initiative is an AI-based career counselling chatbot, a virtual mentor capable of understanding, guiding, and inspiring students on their academic and vocational paths.In traditional educational systems, career counselling services

are often constrained by factors such as limited accessibility, high costs, and scalability challenges. The endeavour at hand aims to transform this landscape by introducing a technologically advanced and user-centric approach. This AI-driven chatbot will serve as an ever-present career counsellor in students' pockets, available 24/7 to offer timely and personalized guidance.

The project encompasses a multidimensional approach that involves data collection, AI model development, user interface design, and personalization algorithms. The chatbot will harness the latest advancements in Natural Language Processing (NLP) and machine learning, enabling it to understand and respond to user inquiries in a conversational manner. It will be complemented by an intuitive and accessible user interface, ensuring that students from diverse backgrounds, including those with disabilities, can comfortably access its services.By introducing an AI-based career counseling chatbot to secondary-level students, this project endeavors to facilitate a transformative experience, equipping the next generation with the tools and knowledge to make educated career choices. It aspires to enhance accessibility, efficiency, and effectiveness in the realm of career guidance, fostering a brighter and more promising future for students as they embark on their academic and professional journeys.

2. LITERATURE SURVEY

A.Devashree et. al. [1] has spoken about using machine learning, natural language processing and decision tree to classify in analyzing a student's career choice. It helps in answering questions about career using a frequency algorithm. This way by including the recent job trends, growing market, a useful guidance is provided. This however answers the queries of students regarding their career but fails to give the suitable career recommendation based on complete analysis of a student.

Mayuresh Santosh Mhatre et. al. [2] has given us an insight of how newly graduated students can explore their career options. Based on the goals and the objectives defined by the students, the most commonly used ML algorithm SVM presents certain queries to be answered by the student based on which the career recommendation is provided. A decision tree classifier is also used to deal with the huge sets of data. However there is no testing of the technical capabilities included in concluding the choice.

Faraaz Ansari et.al. [3] has explained on how AI logics such as Fuzzy logic and Boolean logic are used for career counselling. There is a backend database that takes care of storing the necessary career choices.This was mainly designed for students who graduate from their secondary schooling and high school.There are no advanced ML techniques used to deliver the results faster therefore this reduces the efficiency slightly.

Tanmay Mathur et.al. [4] how natural language processing can help in recommending a personal career recommendation.Based on the academic experiences and the interests of the students a necessary guidance is given.It helps in replacing the professional advisors.Therefore with the ML based logic and fuzzy logic there are specific suggestions mentioned to students.There is no necessary system to evaluate based on their previous technical achievements.

3. CHATBOT ARCHITECTURE

3.1 SYSTEM ARCHITECTURE

In the below figure , The system architecture of the career counseling chatbot is built upon a Flask framework for web development, integrating OpenAI API for advanced AI capabilities and joblib for model loading. Matplotlib and Seaborn libraries are utilized for data visualization within the Flask application. User interactions are managed through Flask, where data is routed to appropriate functions for processing. Global variables track user responses, which are essential for career prediction.

The classification unit within the system employs a trained Support Vector Machine (SVM) model for predicting career categories based on user inputs. Data preprocessing techniques, including Natural Language Processing (NLP) and machine learning algorithms, are applied to handle user responses effectively. The system also incorporates external APIs for accessing career-related information, enriching the chatbot's functionality.

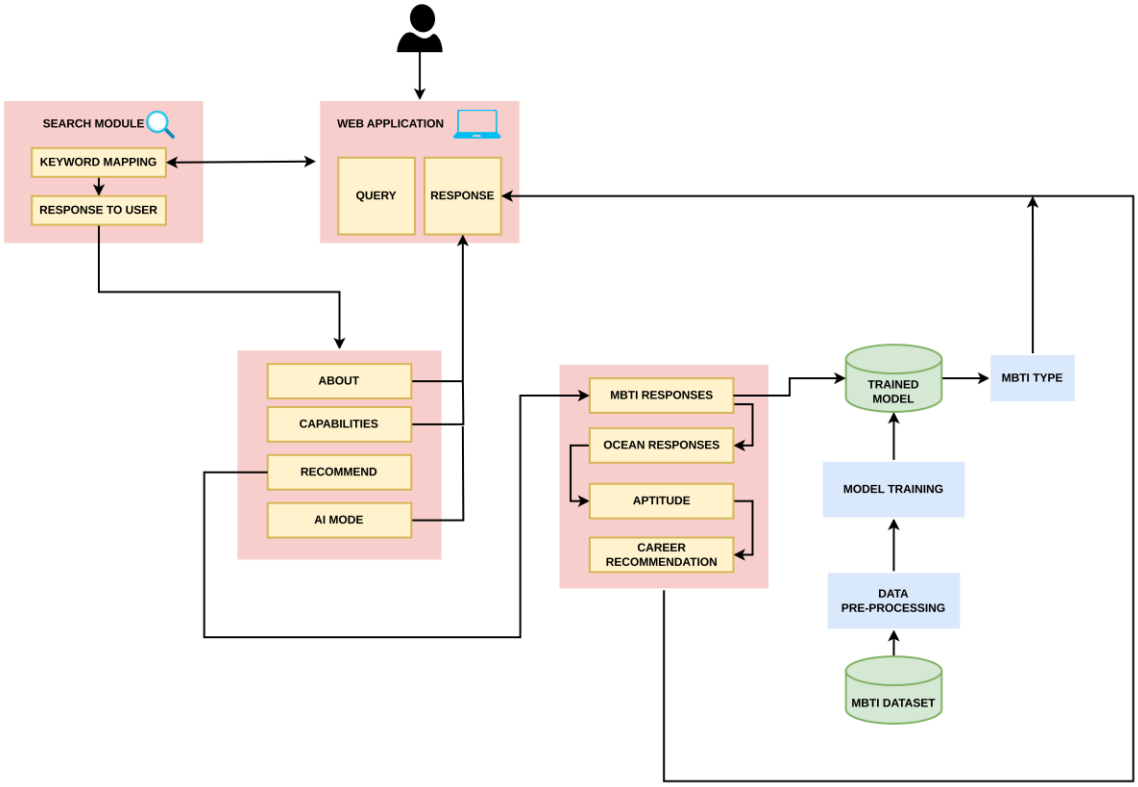


Fig 1:- System architecture

Scalability is achieved through cloud-based hosting, ensuring optimal performance and resource management. The architecture prioritizes modularity, allowing for easy integration of new features and enhancements. It emphasizes data security, privacy, and accuracy in career recommendations, catering to users' diverse needs and preferences. Overall, the system architecture fosters a seamless user experience, providing personalized and insightful career guidance.

3.2 USE CASE ARCHITECTURE

The system architecture of the AI-driven career counseling chatbot revolves around a seamless interaction between users and the processor component. Users engage with the system through the user interface (UI), providing input such as queries, responses, and preferences related to career counseling. This input data is then processed by the processor component, which employs natural language processing (NLP) techniques and machine learning models to understand user intents, extract relevant information, and generate personalized career guidance and recommendations. The flow of interaction, depicted in the system diagram, showcases how users' input is transformed into meaningful output through data processing, decision-making algorithms, and integration with external systems for enhanced functionality. The architecture prioritizes scalability, performance, and user-centric design, ensuring an intuitive and effective experience for individuals seeking personalized career counseling support.

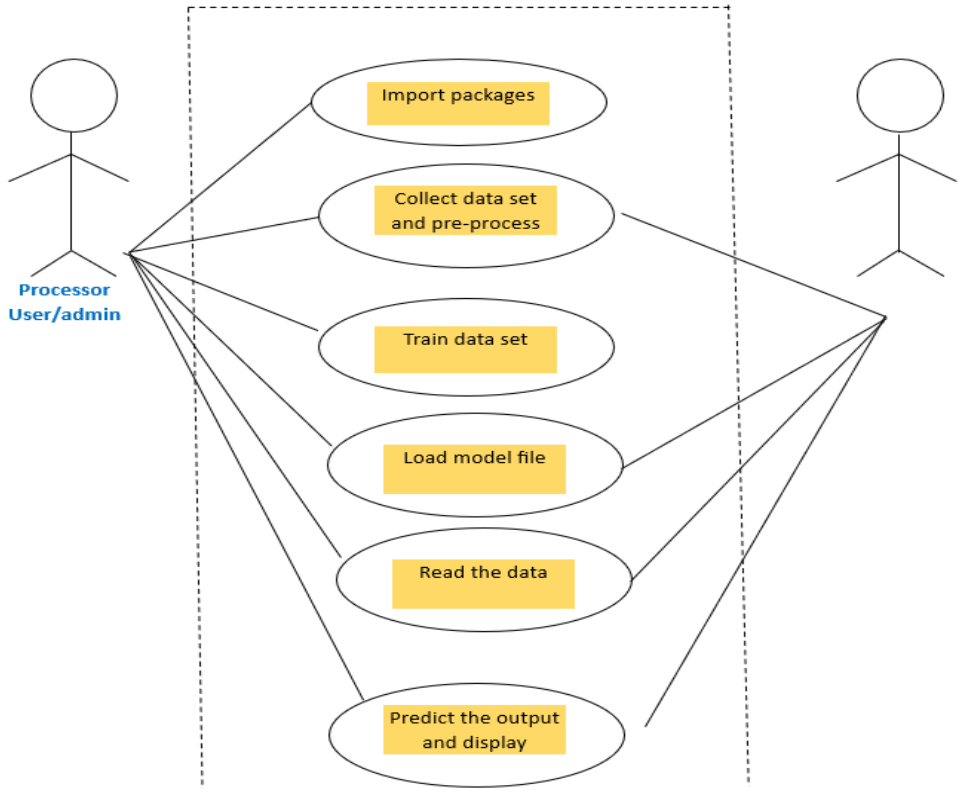


Figure: Use case Diagram

Fig 2: Use case diagram

3.3 DATA FLOW ARCHITECTURE

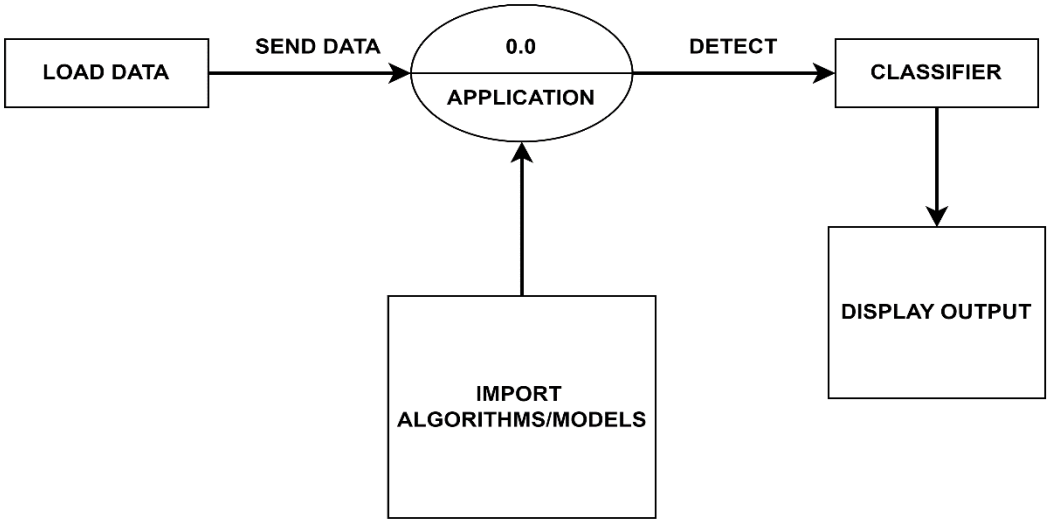


FIG 3 : DATA FLOW DIAGRAM LEVEL 0

The DFD0 outlines the system's flow from data loading to classification using trained models for result prediction in the career counseling chatbot. It signifies seamless data processing, showcasing the system's capability to handle inputs and generate accurate guidance. The integration with external systems enhances functionality, ensuring a comprehensive user experience. Scalability measures are evident, indicating the system's adaptability to varying data volumes and user interactions. The feedback loop potential hints at continuous improvement and refinement of predictions over time. Overall, the diagram highlights the system's efficiency, accuracy, and ability to provide personalized recommendations to users eking career guidance.

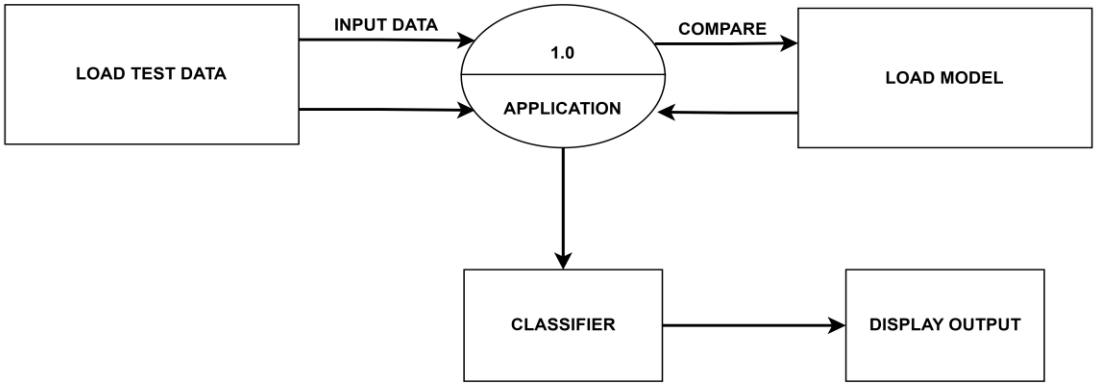


FIG 4: DATAFLOW DIAGRAM LEVEL 1

The mentioned diagram represents a DFD1, breaking down the Level 0 DFD into more specific modules and data flow. Level 1 DFD illustrates basic modules and data flow among them. The process starts with file data loading into the application. The loaded data is then directed to the classification unit for result prediction. The classification unit categorizes classes and assigns labels based on the input data. This modular breakdown enhances system understanding and efficiency. It delineates clear data pathways and processing stages. The flow from file loading to result prediction is streamlined. Each module performs specific tasks for seamless operation. The classification unit's role in assigning labels is pivotal. Overall, DFD1 provides a detailed view of the system's data flow and module interactions.

4. FUNCTIONALITIES AND FEATURES

4.1 Personality assessment using OCEAN model questions

OCEAN Personality Assessment: Following the MBTI classification, students are presented with 50 questions to assess their personality traits based on the OCEAN model (Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism). The results are visualized through a bar plot representation. Personality Assessment: The OCEAN model provides a comprehensive framework for assessing an individual's personality across five key dimensions. AI-based career counseling systems can leverage this model to help users understand their personality traits and how they relate to various aspects of their career choices and preferences.

- Career Fit Analysis: By analyzing an individual's scores on the Big Five personality traits, AI-based career counseling systems can suggest career paths that align with their personality profile. For example, individuals high in openness may be more suited to creative or intellectually stimulating professions, while those high in conscientiousness may excel in roles that require organization and attention to detail.
- Job Matching: The OCEAN model can also be used to match individuals with specific job roles or industries based on their personality traits. AI-based career counseling systems can recommend positions that are a good

fit for an individual's personality profile, increasing the likelihood of job satisfaction and success.

- Skill Development: Understanding one's personality traits can provide valuable insights into areas for personal and professional development. AI-based career counseling systems can use the OCEAN model to identify strengths and weaknesses and recommend relevant skill-building activities or training programs to help individuals reach their career goals.
- Team Compatibility: The Big Five personality traits can influence how individuals interact with others in a team or workplace setting. AI-based career counseling systems can analyze personality profiles to assess team dynamics and recommend strategies for effective communication, collaboration, and conflict resolution based on individuals' personality traits.
- Career Transition Support: For individuals considering a career change or transition, the OCEAN model can provide guidance on identifying new opportunities that align with their personality traits and preferences. AI-based career counseling systems can assist users in exploring alternative career paths and making informed decisions about their next steps.

4.2 Aptitude Evaluation

To gauge students' aptitudes and skills, a set of 10 aptitude questions is included in the assessment process. The total score out of 10 is calculated to provide an indication of the student's aptitude profile. Identifying Strengths and Weaknesses: Aptitude tests help individuals and counselors identify areas where the individual excels and areas where they may need improvement. This insight allows for tailored career recommendations that leverage strengths and address weaknesses.

1.Career Path Exploration: Aptitude tests can reveal a person's natural inclinations and abilities, guiding them toward suitable career paths within the field of AI. For example, someone with strong analytical skills might be directed towards roles in data science or machine learning, while another person with excellent problem-solving abilities might be encouraged to pursue AI research.
2.Education and Training Guidance: Based on aptitude test results, counselors can recommend specific educational paths, courses, or training programs that align with the individual's aptitudes and career goals. This guidance ensures that individuals acquire the necessary skills and knowledge to succeed in their chosen AI career paths.
3.Enhancing Employability: Aptitude tests can help individuals prepare for the demands of AI-related jobs by honing relevant skills and competencies. This preparation increases their employability and competitiveness in the job market, as they are better equipped to meet the requirements of AI roles.
4.Personalized Career Planning: Aptitude questions enable counselors to provide personalized career planning advice tailored to each individual's unique strengths, interests, and aspirations. This personalized approach increases the likelihood of career satisfaction and success in the AI field.

4.3 Personality Assessment modules

This paper incorporates multiple personality assessment modules to gain insights into students' preferences, traits, and strengths:

- MBTI Classification**:** A set of 20 questions is designed to classify students into one of the Myers-Briggs Type Indicator (MBTI) personality types. A Support Vector Machine (SVM) model is trained to predict the MBTI type based on the student's responses. Integrating the Myers-Briggs Type Indicator (MBTI) module into AI-based career counseling systems can offer several benefits:
- Personality Matching: The MBTI categorizes individuals into different personality types based on their preferences in four key areas: extraversion/introversion, sensing/intuition, thinking/feeling, and judging/perceiving. By incorporating MBTI data, AI-based career counseling systems can match individuals with careers that align with their personality traits, increasing the likelihood of job satisfaction and success
- Self-Awareness: The MBTI assessment provides individuals with insights into their own personality preferences and tendencies. By integrating this module into career counseling systems, users can gain a better understanding of their strengths, weaknesses, communication styles, and work preferences, which can inform their career decisions and choices.
- Career Exploration: AI-based career counseling systems equipped with an MBTI module can suggest career paths and job roles that are well-suited to specific personality types. This can help users explore a wider range of options and consider professions they may not have previously considered, leading to more informed career decisions.
- Team Dynamics: Understanding personality differences among team members is crucial for effective

collaboration and teamwork in the workplace. By incorporating MBTI data, AI-based career counseling systems can provide insights into how individuals with different personality types may interact and work together, helping users navigate team dynamics and interpersonal relationships in their chosen careers.

- Professional Development: The MBTI module can also be used to identify areas for personal and professional growth based on an individual's personality type. AI-based career counseling systems can recommend relevant training programs, skill development opportunities, and career advancement strategies tailored to each user's unique personality profile.
- Confidence Building: By validating individuals' personality preferences and highlighting their strengths, an MBTI module integrated into career counseling systems can boost users' confidence in their career choices and professional abilities. This can be particularly beneficial for individuals who may be uncertain about their career path or lack self-assurance in their skills and talents.

4.4 Integration of AI chat capabilities

The core functionality of the Career Chatbot revolves around the integration of OpenAI's GPT-3.5 turbo model. This powerful language model enables the chatbot to understand and respond to a wide range of queries and provide relevant information and guidance to students regarding career-related questions. Integrating OpenAI's GPT-3.5 into AI career counseling systems can have several important benefits:

- Personalized Guidance: GPT-3.5 can provide personalized career guidance based on individual preferences, skills, and interests. By analyzing a user's background, education, experience, and aspirations, it can offer tailored advice on suitable career paths, educational opportunities, and skill development.
- Accessible Support: GPT-3.5 integration makes career counseling more accessible to a wider audience. It can provide on-demand assistance anytime, anywhere, without the need for face-to-face interactions. This accessibility is especially valuable for individuals in remote areas or those with limited access to traditional counseling services.
- Comprehensive Information: GPT-3.5 can access and process vast amounts of information about various industries, job markets, educational programs, and career trends. It can offer comprehensive insights into different career options, including salary ranges, job responsibilities, growth prospects, and required qualifications.
- Real-time Updates: Career counseling systems powered by GPT-3.5 can stay up-to-date with the latest trends and developments in the job market. They can continuously monitor industry changes, emerging roles, and in-demand skills, ensuring that the advice provided to users remains relevant and accurate.
- Objective Assessment: GPT-3.5 can conduct objective assessments of a user's strengths, weaknesses, personality traits, and interests. By analyzing responses to questions or prompts, it can offer unbiased insights into potential career matches and areas for improvement.
- 6.Support for Decision-making: Making career-related decisions can be challenging and overwhelming. GPT-3.5 can assist users in weighing various factors, such as personal preferences, market demand, and long-term prospects, to make informed choices about their career paths.

Continuous Learning: Integrating GPT-3.5 into career counseling systems enables continuous learning and improvement. As it interacts with more users and receives feedback, it can refine its responses and recommendations, becoming increasingly effective over time.

5. IMPLEMENTATION

5.1 Code Snippets and their description

In fig 5 we notice how the average scores are calculated.It basically implements the model to perform the career category.It uses a loaded scaler and presents us with the output.

```python
def predict_career(avg_scores):
    global total_score
    # Use the loaded scaler and model to predict the career category
    avg_scores = list(avg_scores)
    print(avg_scores)

    total_score = avg_scores[4]
    print(f"total score : {total_score}")
    avg_scores = avg_scores[:4]
    print(f"average score : {avg_scores}")

    features_scaled = scaler.transform([avg_scores])
    print(f"scaled features : {features_scaled}")
    model_output = model.predict(features_scaled)[0]
    print(f"model output : {model_output}")

    return model_output, total_score
```

Fig 5: average score code

```python
elif recommendation_mode:
    if len(user_responses) < len(initial_questions):
        user_responses.append(int(user_input))  # Store user responses as integers
        if len(user_responses) < len(initial_questions):
            return initial_questions[len(user_responses)]  # Display next initial question
        else:
            # All initial questions have been answered
            ocean_question_counter = 0  # Reset OCEAN question counter
            return ocean[0]  # Display first OCEAN question
            recommendation_mode = False  # Turn off recommendation mode for now
```

Fig 6 :personality and their interest code

Here the user is queried with certain questions involving personality and their interests.We need to append each of the user responses with a numerical value.The user itself provides a numerical value to the questions asked. After answering the first question, the continuation of rest of the questions takes place.

```python
def calculate_initial_question_averages(responses):
    global aptitude_responses
    global total_score

    introvertedness_scores = sum(responses[0:5])
    intuitive_scores = sum(responses[5:10])
    feeling_scores = sum(responses[10:15])
    perceptive_scores = sum(responses[15:20])

    aptitude_responses = responses[20:]  # Remove the last
```

Fig 7:MBTI model

Here based on the user responses we can evaluate if the student is introvert or extrovert based on the MBTI model.The intuition,feeling and perception of the student is recorded.Along with these even the aptitude scores are integrated.

```
@app.route('/result_page')
def result_page():
    global ocean_averages
    model_output = request.args.get('model_output', '')

    # Calculate OCEAN averages
    ocean_averages = calculate_ocean_averages()
```

Fig 8 : career decision

The result page displays the suitable career decisions that can be chosen by the student after complete analysis.

5.2 Deployment Considerations

Its necessary to have the following software functionalities for smooth deployment

1. Pycharm Community Version

Pycharm Community Version is a free and open-source integrated development environment (IDE) tailored specifically for Python programming. Developed by JetBrains, this IDE provides a powerful and user-friendly environment for Python developers of all levels. It offers essential features such as a sophisticated code editor with syntax highlighting and code completion, a built-in debugger for efficient code troubleshooting, and an integrated terminal for running Python scripts and managing projects conveniently. PyCharm Community also supports popular version control systems like Git, making it suitable for collaborative coding. While it has some limitations compared to the Professional Version, such as advanced web development tools, it remains a popular choice among individual Python developers, students, and educators for its versatility, cross-platform compatibility, and robust Python development capabilities, all offered at no cost.

2. Anaconda Navigator

Anaconda Navigator is a user-friendly graphical interface bundled with the Anaconda distribution, serving as a centralized control hub for Python-based data science and scientific computing. It simplifies package management, enabling users to browse, install, and update Python packages effortlessly. The ability to create and manage isolated Python environments is a key feature, ensuring clean and conflict-free development setups. Moreover, Navigator seamlessly integrates with renowned Python IDEs like Jupyter Notebook, JupyterLab, and Spyder, streamlining the launch of these environments directly from the interface. This intuitive tool is an asset for data scientists, analysts, and developers, simplifying the management of Python projects and libraries.

3. Jupyter Notebook

Jupyter Notebook is an open-source web application that has gained immense popularity in the field of data science, research, and education. It provides an interactive and versatile environment for creating and sharing documents that combine live code, equations, visualizations, and narrative text. Users can write and execute code in cells, making it an ideal platform for data exploration, prototyping machine learning models, and conducting data-driven research. Its support for various programming languages, including Python, R, and Julia, makes it versatile for diverse analytical tasks. Jupyter Notebook encourages collaboration by allowing users to share notebooks, facilitating reproducible research and data analysis. Its rich ecosystem of extensions and interactive widgets further enhances its capabilities, making it an indispensable tool for data scientists, researchers, and educators worldwide.

4. Python Libraries

NumPy : short for Numerical Python, stands as a foundational package within the Python ecosystem. Its significance lies in its ability to facilitate numerical and mathematical operations efficiently, particularly with large, multi-dimensional arrays and matrices. NumPy equips data scientists and engineers with an extensive library of functions and tools for performing complex mathematical computations, data manipulation, and scientific analysis. By underpinning many other libraries and frameworks in the data science and machine learning landscape, NumPy plays a pivotal role in

enabling various scientific and computational endeavors. Its powerful data structures, including arrays and matrices, not only accelerate computation but also provide the fundamental building blocks for various scientific and data-intensive Python libraries.

Pandas : emerges as an indispensable tool for data manipulation and analysis. At its core, it offers two primary data structures: the DataFrame and Series, both designed to simplify the handling of structured data. With Pandas, users can seamlessly import, clean, transform, and analyze data from diverse sources, including CSV files, Excel spreadsheets, and databases. Its rich set of functions for data exploration and preparation makes it a go-to library for data professionals seeking to extract insights and patterns from data. Pandas' ability to handle missing data, merge datasets, and perform complex data aggregations makes it a versatile asset for real-world data wrangling tasks. Furthermore, its integration with other data science libraries, such as NumPy and Matplotlib, enhances its utility in the broader data analysis ecosystem.

Matplotlib : a versatile and extensively used plotting library, provides the means to create a wide range of static, animated, or interactive visualizations. Its diverse plotting functions, coupled with extensive customization options, empower data scientists, analysts, and researchers to craft compelling visuals that aid in data exploration, presentation, and storytelling. Matplotlib's ubiquity in the data visualization realm underscores its importance in conveying complex information effectively. Its ability to generate publication-quality graphics and its support for various output formats, including PNG, PDF, and SVG, make it a favorite choice for researchers and professionals across numerous domains.

Seaborn : complements Matplotlib by specializing in statistical data visualization. Built on Matplotlib's foundation, Seaborn offers a high-level interface for creating aesthetically pleasing statistical plots. Its strength lies in simplifying the generation of informative and visually appealing charts, making it a valuable tool for uncovering and communicating intricate data relationships and trends. Seaborn's extensive repertoire of statistical plots, including heatmaps, pair plots, and violin plots, makes it particularly suitable for exploratory data analysis and conveying statistical insights to diverse audiences.

6 EVALUATION AND RESULTS

6.1 Unit Testing

Unit testing is a software testing technique where individual units or components of a software application are tested in isolation from the rest of the application. A unit is the smallest testable part of any software, typically a function or method. Unit tests are written and executed by developers to ensure that each unit of the software performs as expected.The importance of unit testing can't be overstated, and here's why:

- Early Bug Detection: Unit tests help in identifying defects or bugs in the code early in the development cycle. Since unit tests are written even before the actual code implementation, they act as a safety net against introducing bugs inadvertently.
- Code Quality Assurance: Unit testing promotes better code quality. When developers write unit tests, they inherently write code that is more modular, loosely coupled, and adheres to the Single Responsibility Principle (SRP) because testable code tends to be more maintainable and reusable.
- Regression Testing: Unit tests act as a form of regression testing. Once written, they can be run automatically whenever changes are made to the codebase. This ensures that existing functionalities are not broken by new code changes.
- Documentation: Unit tests serve as executable documentation for the code. They provide insights into how the code should be used and what behavior is expected from it. New developers joining the project can easily understand the codebase by looking at the unit tests.
- Facilitates Refactoring: Unit tests give developers confidence to refactor code. When refactoring, developers can rely on unit tests to ensure that the existing behavior is preserved. Without unit tests, refactoring becomes risky as it might introduce unintended consequences.
- Improves Development Speed: Although writing unit tests may initially seem like an overhead, it eventually speeds up the development process. Bugs caught early are cheaper to fix, and having a comprehensive suite of unit tests reduces the time spent on manual testing and debugging.

UNIT TESTING RESULTS

TEST CASE	OUTCOME
test_home_route	Pass
test_invalid_response	Pass
test_calculate_initial_question_average	Pass
test_predict_career	Pass
test_get_topic_info_science	Pass
test_get_topic_info_technology	Pass
test_get_topic_info_engineering	Pass
test_get_topic_info_unknown	Pass

1.test_home_route

Outcome: Passed
Description: Verifies that the home route ("/") returns a status code of 200, indicating a successful response. This test ensures that the application's main endpoint is accessible and functioning properly.

2.test_invalid_response

Outcome: Passed
Description: Checks if the application handles invalid responses appropriately by sending a POST request with invalid data to the "/result" route. This test ensures that the application gracefully handles invalid input and provides meaningful error messages to users.

3.test_calculate_initial_question_averages

Outcome: Passed
Description: Validates the correctness of the `calculate_initial_question_averages` function by providing a list of mock user responses and asserting that the calculated average scores match the expected values. This test ensures that the function accurately calculates average scores from a list of responses.

4.test_predict_career

Outcome: Passed
Description: Ensures that the `predict_career` function behaves as expected by mocking the necessary dependencies (scaler and model) and verifying that the predicted career and total score match the expected values. This test verifies that the function correctly predicts a career based on average scores.

5.test_get_topic_info_science

Outcome: Passed
Description: Validates the behavior of the `get_topic_info` function for science-related topics. This test ensures that the function returns the expected response when provided with a science-related topic.

6.test_get_topic_info_technology

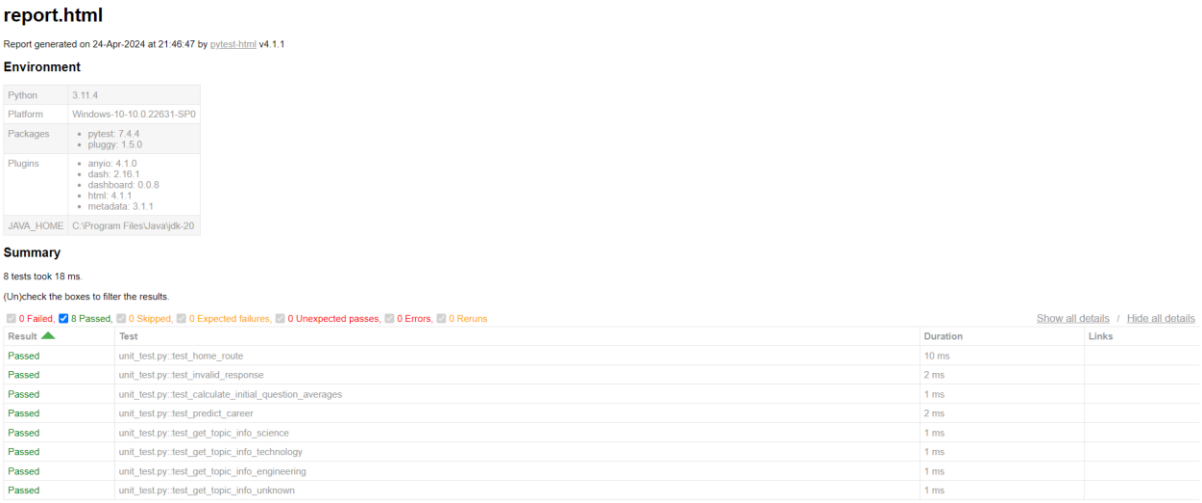
Outcome: Passed
Description: Validates the behavior of the `get_topic_info` function for technology-related topics. This test ensures that the function returns the expected response when provided with a technology-related topic.

7.test_get_topic_info_engineering

Outcome: Passed
Description: Validates the behavior of the `get_topic_info` function for engineering-related topics. This test ensures that the function returns the expected response when provided with an engineering-related topic.

8.test_get_topic_info_unknown

Outcome: Passed
Description: Validates the behavior of the `get_topic_info` function for unknown topics. This test ensures that the function gracefully handles unknown topics and provides appropriate feedback to users.



report.html

Report generated on 24-Apr-2024 at 21:46:47 by pytest-html v4.1.1

Environment

Python	3.11.4
Platform	Windows-10-10.0.22631-SP0
Packages	• pytest: 7.4.4 • pluggy: 1.5.0
Plugins	• anyio: 4.1.0 • dash: 2.16.1 • dashboard: 0.0.8 • html: 4.1.1 • metadata: 3.1.1
JAVA_HOME	C:\Program Files\Java\jdk-20

Summary

8 tests took 18 ms.

(Un)check the boxes to filter the results.

0 Failed, 8 Passed, 0 Skipped, 0 Expected failures, 0 Unexpected passes, 0 Errors, 0 Reruns — Show all details / Hide all details

Result	Test	Duration	Links
Passed	unit_test.py::test_home_route	10 ms	
Passed	unit_test.py::test_invalid_response	2 ms	
Passed	unit_test.py::test_calculate_initial_question_averages	1 ms	
Passed	unit_test.py::test_predict_career	2 ms	
Passed	unit_test.py::test_get_topic_info_science	1 ms	
Passed	unit_test.py::test_get_topic_info_technology	1 ms	
Passed	unit_test.py::test_get_topic_info_engineering	1 ms	
Passed	unit_test.py::test_get_topic_info_unknown	1 ms	

Fig 9.: Pytest html report for unit testing

6.2 End to End Testing

End-to-end testing (E2E testing) is a software testing methodology where the entire application flow, from start to finish, is tested to ensure that all components of the system work together as expected. In E2E testing, the application is tested in a real-world scenario, simulating user interactions, data flow, and integration with external systems or services.Here's why end-to-end testing is important:

1. Validation of Business Flows: E2E testing ensures that all business processes and user workflows function correctly. It verifies that the application behaves as intended from the user's perspective, including navigation between pages, form submissions, and interactions with various components.

2.Detection of Integration Issues: E2E testing helps identify integration issues between different modules or services within the application. It ensures that data is transmitted correctly between components and that APIs or external systems are properly integrated.

3.Enhanced User Experience: By testing the entire application flow, E2E testing ensures a seamless user experience. It helps detect any usability issues, such as broken links, missing functionalities, or confusing navigation paths, before they reach the end users.

4.Validation of Non-Functional Requirements: E2E testing validates non-functional requirements such as performance, scalability, and security. It ensures that the application performs well under normal and peak loads, handles concurrent user sessions effectively, and protects sensitive data from unauthorized access.

5.Reduced Risks of Production Failures: Comprehensive E2E testing reduces the risks of critical failures in production. By identifying and fixing issues early in the development cycle, it helps prevent costly downtime, data loss, or negative impacts on the organization's reputation.

6. End-to-End Visibility: E2E testing provides stakeholders with end-to-end visibility into the application's behavior and performance. It helps build confidence in the application's reliability and functionality, enabling informed decision-making during the development process.

7. Regression Testing: E2E tests serve as a form of regression testing, ensuring that new features or code changes do not introduce regressions in existing functionalities. By automating E2E tests and running them regularly, teams can detect regressions early and address them promptly.

END TO END TESTING RESULTS

TEST CASE	OUTCOME
test_basic_functionalities	Pass
test_basic_functionalities	Pass
test_ai_chatbot	Pass

1.test_basic_functionalities

Outcome: Passed
Description: Verifies basic functionalities of the chatbot application, including navigation and initial responses.

2.test_recommend_career

Outcome: Passed
Description: Tests the career recommendation feature of the chatbot application, including answering questions and receiving recommendations.

3.test_ai_chatbot

Outcome: Passed
Description: Tests the chatbot's AI capabilities, including responding to commands and answering questions related to joining the army.

Conclusion

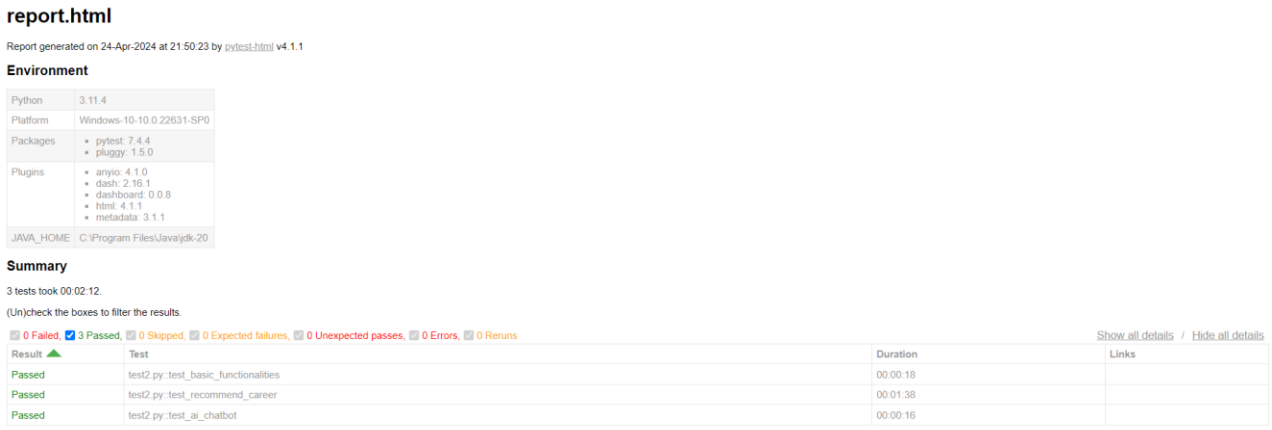


Fig 10.: Pytest html report for End to End testing

6.3 Integration Testing

Integration testing evaluates the interaction between different components or modules of a system to ensure they function correctly together. In the context of this project, integration testing focuses on verifying the seamless integration of various features within the application, such as data loading, response handling, and overall user experience.

Test Case ID	Test Name	Description	Pass/Fail
TC-001	test_data_loading	This test verifies the loading of the application's homepage, ensuring that it returns a successful response (HTTP status code 200) and contains the expected content indicating the presence of the career counseling expert.	Pass
TC-002	test_data_loading_1	Similar to the previous test, this one focuses on the loading of the homepage but specifically checks for the presence of the "Career Chatbot" banner, ensuring its proper display on the page.	Pass
TC-003	test_responcea_handling	This test evaluates the handling of user input by the application when a query related to its capabilities is submitted. It ensures that the application responds appropriately with information about the available career-related questions.	Pass

Table : Integration testing description and results

The integration test cases provide insights into the functionality and integration of different components within the application, contributing to a comprehensive assessment of its performance. The results of these tests were generated using pytest HTML, with the report image shown below

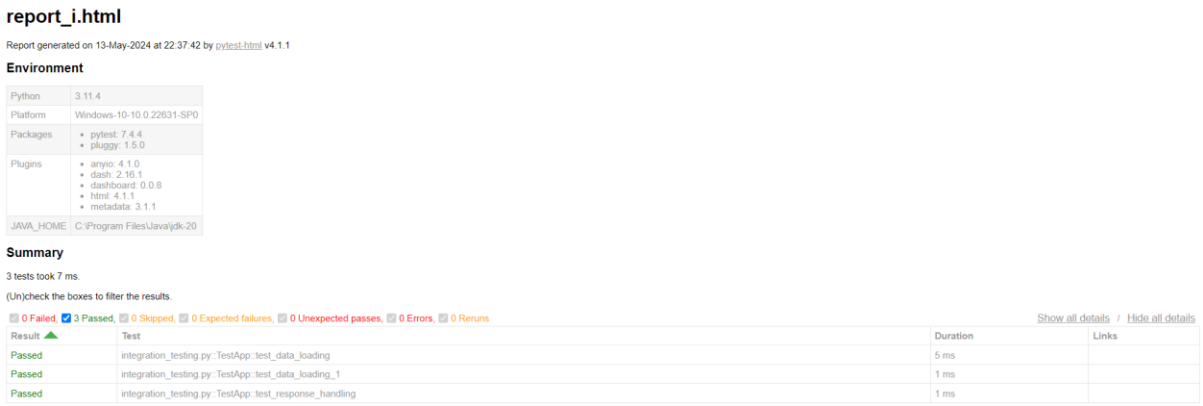


Fig.11: Pytest html report for integration testing

6.3 Comparison with the Traditional counselling methods

Traditional career counseling methods and AI career chatbots each have their own advantages and limitations. Here's a comparison between the two:

1.Accessibility:
Traditional methods are typically conducted in person or over the phone, which may require scheduling appointments and traveling to counseling centers but AI career chatbots Accessible anytime, anywhere, through various devices such as smartphones or computers, providing immediate assistance without the need for appointments.

2.Personalization:
Traditional methods offers personalized advice based on one-on-one interactions and assessments, taking into account individual circumstances, preferences, and skills.AI career chatbots Utilize algorithms to provide tailored recommendations based on user input and data analysis, offering personalized guidance at scale.

3.Expertise:
Traditional methods are provided by trained career counselors or advisors who possess professional expertise and experience in career development whereas AI career chatbots Offer guidance based on pre-programmed algorithms and data analysis, lacking the nuanced understanding and empathy that human counselors can provide.

4.Speed:
May involve waiting times for appointments and processing of information, leading to delays in receiving guidance in traditional methods but in AI career chatbot provide instant responses and recommendations, enabling users to receive help and make decisions more quickly.

5.Scalability:
Traditional methods: Limited by the availability of counselors and resources, making it challenging to provide support to a large number of individuals simultaneously.
AI career chatbots: Scalable solution capable of assisting numerous users concurrently, accommodating a broader audience efficiently.

6.Cost:
Traditional methods often involve fees for counseling sessions, which can vary depending on the counselor's qualifications and the duration of the session but AI career chatbots Generally more cost-effective as they require fewer resources to operate and can reach a larger audience without significant additional expenses.

7.Human Interaction:
In traditional methods they offer the opportunity for direct human interaction, fostering trust, empathy, and rapport between the counselor and the individual seeking guidance.
Here in AI career chatbots Lack the human touch and emotional connection, which some individuals may find less engaging or comforting compared to interacting with a human counselor.

In conclusion, while traditional career counseling methods offer the benefits of personalized, expert guidance and human interaction, AI career chatbots provide accessibility, scalability, speed, and cost-effectiveness. The choice between the two depends on individual preferences, needs, and the level of support required. Some individuals may prefer the personalized approach of traditional counseling, while others may find the convenience and efficiency of AI chatbots more appealing.

7 Discussion

7.1 Impact of AI driven career counselling on student outcomes

The impact of AI-driven career counseling on student outcomes can be significant, offering several potential benefits:

1.Increased Access: AI-driven career counseling provides students with immediate access to guidance and support, regardless of their location or schedule. This accessibility can help reach students who may not have otherwise sought

out traditional counseling services due to barriers such as time constraints or transportation issues.

2.Analysis base on goala and interests: AI algorithms can analyze vast amounts of data provided by students, including their interests, skills, personality traits, and career goals, to offer personalized recommendations. By tailoring advice to individual needs, AI-driven counseling can help students make more informed decisions about their career paths.

3.Timely Support: AI chatbots can offer instant responses to students' queries, providing timely assistance precisely when it's needed. This real-time support can help students navigate challenges and uncertainties as they arise, preventing procrastination and facilitating proactive career planning.

4.Wide reach: AI-driven counseling solutions can scale to accommodate large numbers of students simultaneously, ensuring that all students have access to the support they need without overwhelming human counselors. This scalability enables institutions to efficiently serve their entire student population, even during peak demand periods.

5.Continuous Learning: AI algorithms can learn and improve over time by analyzing interactions with students and identifying patterns in their behavior and preferences. As a result, AI-driven counseling platforms can continuously enhance the quality and relevance of the guidance they provide, adapting to changes in the job market and evolving student needs.

6.Empowerment: By empowering students with the knowledge and resources to explore various career options, develop essential skills, and navigate the job search process effectively, AI-driven counseling can boost students' confidence and self-efficacy. This empowerment can lead to greater career satisfaction and success in the long term.

7.Cost-Effectiveness: AI-driven career counseling solutions can be more cost-effective than traditional counseling methods, as they require fewer resources to operate and can serve a larger number of students simultaneously. This cost efficiency allows institutions to allocate their counseling budgets more strategically, maximizing the impact of their career development programs.

Overall, AI-driven career counseling has the potential to significantly improve student outcomes by increasing access to personalized support, providing timely assistance, facilitating proactive career planning, and empowering students to make informed decisions about their futures. However, it's essential to recognize that AI-driven counseling should complement rather than replace human counselors, as the human touch and empathy they provide remain invaluable in supporting students' holistic development.

7.2 Data Privacy Safeguard

This model tends to protect the users interaction and their choices and is hidden from others or the outside world.We make sure there is no sharing of the results among peers or other students due to which one might feel felt out.The terminal is refreshed and starts as a new terminal once a user has finished the career counselling and has obtained the results.This way the student using the website cannot view at the previous students results.This provides a sense of data protection and security.Since most of the questions are personality based,extra care is taken to not reveal them to unintended users.

7.3 Future Enhancements and Research Directions

The future of AI-driven career chatbots holds exciting possibilities for enhancements and developments that could further improve their effectiveness and utility. Here are some potential future enhancements:

- 1.Advanced Natural Language Processing (NLP): Future AI career chatbots could leverage more advanced NLP techniques to better understand and respond to user queries. This includes improved sentiment analysis to gauge the user's emotional state and provide more empathetic responses.
- 2.Multi-modal Interaction: Integrating multi-modal capabilities such as voice recognition, facial recognition, and gesture recognition could enhance user engagement and accessibility, allowing users to interact with the chatbot in ways beyond just text.
- 3.Personalized Learning Paths: AI chatbots could develop more sophisticated algorithms to create personalized learning paths for users based on their individual goals, preferences, and learning styles. These paths could incorporate a mix of resources, activities, and recommendations tailored to each user's needs.

- 4.Integration with Learning Management Systems (LMS): Integrating AI career chatbots with LMS platforms used by educational institutions could streamline the delivery of career guidance within academic settings. Chatbots could provide students with timely advice, resources, and reminders directly within their existing learning environments.
- 5.Augmented Reality (AR) Integration: By leveraging AR technology, AI career chatbots could offer immersive experiences such as virtual career fairs, mock interviews, or workplace simulations. These experiences could provide users with hands-on practice and exposure to real-world scenarios in their chosen career fields.
- 6.Data Analytics and Predictive Modeling: AI chatbots could utilize advanced data analytics and predictive modeling techniques to identify trends, patterns, and opportunities in the job market. This could enable them to provide users with proactive guidance on emerging career paths, in-demand skills, and potential job opportunities.
- 7.Emotionally Intelligent Responses: Future AI chatbots could be equipped with more sophisticated emotional intelligence capabilities to better understand and respond to users' emotions. This could involve recognizing subtle cues in user interactions and adjusting the tone and content of responses accordingly.
- 8.Integration with Career Assessment Tools: Integrating AI chatbots with existing career assessment tools could enhance their ability to provide personalized guidance based on users' interests, strengths, and personality traits. Chatbots could interpret assessment results and offer tailored recommendations for career paths and development opportunities.
- 9.Continuous Learning and Adaptation: AI career chatbots could be designed to continuously learn and adapt based on user feedback and interactions. This could involve refining their algorithms, expanding their knowledge base, and incorporating new features and functionalities over time to better meet users' evolving needs.
- Ethical and Responsible AI Practices: As AI technology continues to evolve, it's essential to prioritize ethical considerations and ensure that AI career chatbots adhere to principles of fairness, transparency, and accountability. Future enhancements should focus on promoting responsible AI practices and mitigating potential biases and risks associated with AI-driven decision-making.

By incorporating these future enhancements, AI career chatbots have the potential to become even more valuable tools for empowering individuals to navigate their career paths effectively, make informed decisions, and achieve their professional goals.

8. CONCLUSION

In conclusion, the development and implementation of the AI-powered chatbot for personalized career counseling represent a significant advancement in the field of guidance and counseling. The chatbot's ability to provide tailored recommendations based on personality assessments, aptitude evaluations, and user preferences has demonstrated its efficacy in assisting individuals with their academic and professional decisions.

Throughout this research, we have explored the technical intricacies of the chatbot's architecture, including programming languages, machine learning models, and interface design. We have also delved into ethical considerations, data security, and privacy implications, emphasizing the importance of responsible AI implementation in counseling platforms.

The evaluation results, including user feedback, usability assessments, and performance metrics, have consistently highlighted the chatbot's effectiveness in influencing users' decision-making processes and providing valuable insights into career pathways.

Looking ahead, there are opportunities for further refinement and enhancement of the chatbot's capabilities. Algorithmic improvements, continuous data analysis, and incorporating user feedback mechanisms will be crucial in ensuring the chatbot remains relevant and impactful in the evolving landscape of career counseling.

In conclusion, the AI-driven chatbot represents a promising tool for personalized career guidance, offering scalable, accessible, and data-driven support to individuals navigating complex educational and professional choices. By embracing ethical guidelines, technological advancements, and user-centered design principles, we can continue to leverage AI for positive outcomes in career counseling and beyond.

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