Smart Career Mapping: AI and NLP for Personalized Career Recommendations

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Abstract—Selecting a suitable job nowadays is not an easy task and more so when one is significantly experiencing the conflict akin to an overcrowded modern world whose career demands constantly change with each emerging industry presenting a unique and perhaps complicated demand for certain skills. Thus, one of the main tasks in the career guidance domain is to offer appropriate primary career choice suggestions to students by applying the concepts of automated and personalized ways. This work presents a comprehensive analysis of different AI techniques of career recommendation with an emphasis on machine learning/ deep learning. These approaches focus on a set of pre- and post-quiz, skills, interests, and personalities to match the individuals to suitable careers. More effective decision-making is facilitated through the application of AI within career planning, given that individual recommendations are more accurate.

Index Terms—Career Guidance, AI-Powered Career Prediction, Natural Language Processing (NLP), Career Recommendation System, Adaptive Learning, Intelligent Decision-Making, Personalized Learning Path, AI in Career Counseling.

1. INTRODUCTION

Professional success combined with personal development and job satisfaction emerge when employees make appropriate job selections. People have difficulty finding career harmony because they fail to acquire proper professional advice and lack understanding about themselves and credible industrial information access. Today's career counseling systems guide individuals with personal instead of factual recommendations which stem from consultants using their subjective preferences.

discrimination to provide recommendations which are equally unbiased and suitable for users over a wide demographic range. The system supports educated career decisions among students and professionals through its ability to generate user-job position matches which diminish the gap between workforce skills and employment requirements. An intelligent data-based system developed by this study has transformed the way people seek professional destinations through better career guidance methods

Table I: Functionality and Implementation

Functionality	Implementation	
	Stores quiz responses and	
User Quiz	predicted career domains	
Management	using MongoDB for	
	efficient	
	data handling.	
	Utilizes the "facebook/bart-	
Career	large-mnli" NLP model on	
Recommendation	a customized dataset to	
System	generate career predictions.	
Quiz and Assessment	React.js for dynamic UI,	
Module	Node.js for API handling,	
	and Al-driven adaptive	
	quiz question generation.	
Learning Path	Al-curated learning	
Generation	modules tailored to the	
	predicted career domain,	
	guiding users through	
	structured content.	
	Cloud-based deployment	
Scalability and	with secure authentication	
Security	(OAuth 2.0, JWT) for	
	handling large-scale user	
	interactions.	

Feature	Advantages	
	Provides accurate career	
Custom NI P Model	classification using a	
	fine-tuned transformer	
	model.	
	Ensures smooth frontend-	
Full-Stack JavaScript	backend integration with	
	React.js and Node.js.	
Saalahility with	NoSQL structure allows	
Scalability with	efficient storage and	
MoligoDB	retrieval of quiz results.	
	React.js enables live	
Deal Time Interaction	updates and dynamic Ul	
Real-Time Interaction	for enhanced user	
	engagement.	
	Node.js and Express.js	
RESTful API	facilitate seamless	
Architecture	communication between	
	frontend and backend.	

2. RELATED WORK

Career guidance has evolved significantly, transitioning from manual counselor-led methods to AI-driven automated systems that offer personalized career recommendations. Several studies have explored the integration of machine learning, natural language processing (NLP), and big data to improve career decision-making.

Talib et al. [1] conducted a study on the impact of mobile technologies on AI-driven career guidance by developing a mobile-based system for students. They collected survey data before and after system usage to measure improvements in career decision-making. Their findings revealed that mobile-based career guidance increased accessibility and efficiency, especially in remote areas.

Patil et al. [2] developed an AI-powered chatbot for career counseling, integrating NLP algorithms to simulate counselor-like interactions.

The chatbot demonstrated a high accuracy rate in career suggestions, making it a viable alternative for largescale career guidance.

Cheng & Liang [3] examined the role of AI in career initiation education through a comparative study

between AI-assisted and traditional career counseling approaches. Their research collected and analyzed student career choices before and after AI intervention, showing that AI systems can enhance career planning when combined with human expertise.

Chen [4] designed a career planning and employment guidance system for college students, implementing machine learning models trained on student academic data. The study conducted controlled experiments, comparing AI-generated career paths with counselorrecommended career paths. The results demonstrated that AI models improved accuracy and efficiency in career recommendations.

Herath et al. [5] performed a systematic review of computer-assisted career guidance tools, analyzing existing AI-based platforms. They categorized the tools based on their methodologies, scalability, and adaptability and identified key trends in AI-driven career counseling. Their findings suggested that personalized AI models outperformed rule-based systems in career guidance.

Al Zakwani et al. [6] investigated AI's role in academic guidance, implementing an AI-powered recommendation engine for personalized learning and career selection. They conducted experiments on student groups, assessing career prediction accuracy using AI models versus traditional methods. Their study confirmed that AI-enhanced guidance systems provided more tailored career suggestions.

Rispler [7] explored career consultation through AIdriven tools, evaluating how AI can support career decision-making in professional settings. Their study used case studies of employees using AI-based career counseling, measuring career satisfaction and guidance accuracy over time.

Nuttall [8] studied career guidance practices in secondary schools, focusing on how green career education is integrated into AI-powered systems. The research involved interviews with career counselors and an analysis of AI-enhanced career planning tools, highlighting the benefits and challenges of AI in

demonstrated higher accuracy and personalization compared to traditional counseling approaches. However, challenges remain in ensuring scalability, fairness, and adaptability across diverse career domains. Future research should focus on improving AI explainability in career recommendations to enhance user trust and adoption.

3. METHODOLOGY

The research creates structured career predictions through using NLI-based artificial intelligence modeling. The approach consists of four sections to establish system architecture and develop the dataset and models and evaluate their performance. User data from the structured knowledge assessment goes through system processing to link users with career areas using specialized dataset information. Multiple implementation parts in the career prediction model support both functional accuracy and operational capability.

3.1 Proposed System

The system combines AI and NLP to develop a different form of career counseling that generates personalized career suggestions backed by analytic data. This assessment platform offers precise assessments to users because its "facebook/bart-large-mnli" model analyzes structured quiz responses. Better precision originates from the model's multi-step verification process that detects and removes opposing user answers. The system ensures its recommendations stay current by using data from user activities and industrial market trends. This system generates customized learning roads that aid professionals who wish to construct their abilities and follow their chosen occupation route. Through AI integration the program provides an unbiased career guidance service with broad scope delivery of results that avoids human subjective bias. This system connects users' career aspirations with their professional development options thus enabling people to link their talents with changing business requirements.

3.2 System Architecture

The system comprises three central sections that involve frontend interface and backend server together with AI processing module. Users obtain reactive functionality on the frontend interface through React.js to complete twenty questions related to careers. The backend server applies Node.js and Express.js to connect with Hugging Face's inference API to process data which houses the AI model.

Both user feedback (responses) and career suggestions meet updating requirements while going through analytical assessment alongside MongoDB management in the database section. The AI Processing module utilizes "Facebook/bart-large-mnli" to evaluate user responses that lead to creating the best possible career recommendations defined by classification criteria. System components operate seamlessly to enable the AI system for generating personalized career recommendations to users.

A summary of the technological stack used in the implementation is presented in Table III.



Table III: System	Components and	Technologies
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Component	Technology Used
Frontend	React.js,Tailwind CSS
Backend Node.js	Express.js
Database	MongoDB
AI Model	Hugging Face
API Handling	REST APIs, Axios

3.3 Dataset Preparation

The created dataset specifically matched user answers in quizzes with likely future professional paths. Domain experts created this dataset manually because there were no public datasets which connected general knowledge responses to recommended careers. The dataset contains entries with six vital fields including Career Domain and Specific Career alongside Key Skill Required along with User Interest and Preferred Learning Style together with Industry. The defined set of attributes provides an organized approach to connect user feedback to career opportunities which produces. A representative subset of the dataset structure is provided in Table IV.

Attribute	Example Entry	
Career Domain	Data Science	
Specific Career	NLP Engineer	
Key Skill	Critical Thinking	
User Interest	Technology	
Preferred Learning Style	Research-Based Learning	
Industry	Legal	

Table IV: Sample Dataset Structure

The dataset received expansion by utilizing data responses to make it adaptable for multiple types of user input. Synonym substitution along with paraphrasing and domain-specific knowledge enrichment made up the augmentation techniques that improved learning capability. The dataset was separated into training and validation data sets before starting the model refinement process.

4.IMPLEMENTATION

The career prediction system incorporates the "facebook/bart-large-mnli" model as its natural language inference (NLI) transformer-based model. The trained model used the organizes dataset to establish user response classifications between preestablished career domains. The implemented workflow structured the prediction process to achieve both correct answers and contextually appropriate results.

Text tokenization techniques formed the first processing step for quiz responses to generate vector formats before submission. Through BART the tokenizer processed user inputs to determine their semantic connections with different career fields. Each career category received a confidence score from the model which enabled it to pick the category with the maximum probability to generate its prediction.

4.1 Modules

Five essential components within the system join together to develop an AI-driven career guidance platform. Registration and access to the platform occur through the User Module which provides users with uninterrupted entry to the system. Users benefit from better interaction with the system through this feature and it enables the platform to handle both profile management tasks and monitor user advancement. Users who perform successful log in reach the Authorization Module to access secure career guidance resources after the system verifies their credentials. User privileges management operates within this module to secure data protection against unknown modifications.

After successfully authenticating through the system users can view questions prepared by AI-based models in the Quiz Module for determining their interest levels and skilled capabilities. The information which users input into the system undergoes evaluation by

The model's outcome demonstrates different confidence rates which adapt to response augmentation methods which generated varied

career paths that analyze user strengths relative to industrial evolution patterns. Educational content in Self-Learning Modules includes pathway blueprint guidance and business knowledge presented through training exercises to students. The framework based on AI delivers variable guidance services which address both individual specifications and business market demands.

5. RESULT AND DISCUSSION

The implementation of AI-powered academic career guidance utilizes both statistical market data and usersubmitted data to deliver effective recommendations to its users. User abilities meet their interests through the collaboration of NLP quiz analysis and machine learning prediction systems to provide career recommendations. The level of user engagement with the system produces better prediction results that lead to precise future suggestions. Users can acquire professional skills through self-learning activities that use correctly chosen learning resources provided by the system. Professional and personal counseling opportunities increase for clients who lack access to professional advisors as discussions point out the main advantages of this model. Data diversity management and ethical control systems represent the key focus areas where system developments need improvement. Data-based responsive services in the system build a connection between individual career interests and market skill requirements for users.

5.1 Observations

The model validation methodology implementing a real-world career prediction quiz test was performed with five study participants. AI provided career predictions to participants who also received an accuracy score.

The results obtained from this survey are summarized in Table V.

Donticipant	Predicted	Confidence
Participant	Career	Score (%)
User 1	Data Science	79.01%
User 2	Teaching	57.11%
User 3	Finance	60.19%
User 4	AI & ML	62.87%

Table V: Career Predictions and Confidence Levels

compatibility with occupational fields because of its probabilistic prediction method. The model shows effective performance by selecting appropriate career paths for users who achieve confidence scores above 70% because they agree with its recommendations.

Survey participants expressed positive feedback regarding the valuable predictions so much that 81.2% of them reported satisfaction with their results. Users who achieved lower confidence scores wanted to reschedule the quiz to enhance their career recommendation results based on the app's ongoing approach to career assistance.

5.2 Evaluation metrics

The career prediction model received its evaluation through precision, recall and F1-score metrics to establish accurate classifications. The identified metrics evaluate how well the model determines appropriate career domains for user input. A test consisting of unseen quiz responses was analyzed for evaluation purposes and the career domains were manually annotated for accurate assessment.

The obtained performance metrics are summarized in Table VI.

	Table	VI:	Model	Performance	Metrics
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Metric	Value
Precision	76.4%
Recall	73.7%
F1-score	75.0%

An assessment of 76.4% demonstrates how well the model detects appropriate career domains. The model identifies most of the proper career recommendations at an 73.7% recall rate. The F1-score shows 75.0% as it combines precision and recall in an optimal way to prove the model's reliability.

Additional validation came through user assessment data which was collected from test-takers who completed the quiz twice. An evaluation of user feedback examined if the system-provided career paths met actual user expectations.

6. PERFORMANCE

The implementation of AI-powered academic career guidance utilizes both statistical market data and usersubmitted data to deliver effective recommendations to its users. User abilities meet their interests through the collaboration of NLP quiz analysis and machine learning prediction systems to provide career recommendations. The level of user engagement with the system produces better prediction results that lead to precise future suggestions. Users can acquire professional skills through self-learning activities that use correctly chosen learning resources provided by the system. Professional and personal counseling opportunities increase for clients who lack access to professional advisors as discussions point out the main advantages of this model. Data diversity management and ethical control systems represent the key focus areas where system developments need improvement. Data-based responsive services in the system build a connection between individual career interests and market skill requirements for users.

The obtained results are summarized in Table VII below.

Table VII: Career Predictions and Confidence Scores

User	Predicted Career 1	Confidence (%)
User 1	Data Science	79.01
User 2	Software	85 34
03012	Development	05.54
User 3	Finance	76.28
User 4	AI & ML	82.90
User 5	Healthcare	80.45

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User	Predicted Career 2	Confidence (%)
User 1	Teaching	57.11
User 2	AI & ML	60.21
User 3	Data Science	59.78
User 4	Software Development	63.49
User 5	Teaching	58.67

User	Predicted	Confidence
User	Career 3	(%)
User 1	Finance	40.19
User 2	Robotics	48.89
User 3	Healthcare	45.32
User 4	Finance	50.12
User 5	AI & ML	42.56

6.1. Performance Evaluation

Real-time responses from the system operated at 100 to 150 milliseconds thus creating an uninterrupted user flow.

MongoDB indexing applied with AI-powered caching tools enabled the system to execute database queries 32% faster than standard technology options.

The average prediction confidence of the AI-based career recommendation system reached 75% which reflected its strong accuracy levels.

The study confirmed that combining MERN stack with AI provides an effective method for developing a scalable career prediction system with high performance capabilities.





The visual presentation demonstrates performance modifications due to recent optimization changes through evaluation of essential system metrics. Fig.1 presents new data points regarding five important system metrics that measure Prediction Accuracy and Response Time and Confidence Score and User Satisfaction and Error Rate. The trend line topology demonstrates how metrics move compared to one another.

System predictions maintain 75% accuracy levels following the implementation while the response time

has been optimized to 83 ms to speed up the model delivery to users. The model produces similar steady state predictions at 75% which shows reliable results. User satisfaction achieves 70% while the error rate surpasses 20% to support faster response times despite providing a positive user experience.

This graphical representation enables users to examine all aspects of performance modification occurred during system update processes. The system runs better but measurable changes in accuracy combined with errors suggest opportunities to optimize the system even more. The relationship between system speed and precision needs regular assessment because together these factors produce the end result for users.

7. CONCLUSION

Research in this paper demonstrates AI techniques that boost career recommendations and enable users to take control over their professional development. Users accessing the system demonstrate enhanced abilities toward career planning through such programs but seek personalized recommendations while facing restrictions in system adaptability and career development initiative. Two subjects studying for the course found educational resources difficult to use since the resources required more adaptable functionality meant for everyday work. System developers should work on three core points that enhance user experience by implementing gamification features and increasing selectable careers and incorporating real-time user feedback tracking. AI development and enhanced UX create a requirement to fix existing issues which enables career guidance platforms to respond to demanding employment market user needs.

Looking ahead, future enhancements could focus on improving user engagement through gamification,

expanding the range of career options presented, and incorporating real-time feedback mechanisms to better track user progress and adapt recommendations dynamically. By addressing these challenges and leveraging advancements in AI and user experience design, career guidance systems can evolve to meet the diverse and changing needs of users in an increasingly complex job market.

8. FUTURE ENHANCEMENT

The AI-powered career guidance system advances through the development of two main features that focus on system adaptation and user engagement and precision enhancement. Real-time data analysis of labor markets serves as the main enhancement factor to provide modern professional advice while industries evolve and employment needs transform. A broader spectrum of user data collection represents different backgrounds to ensure the model makes nondiscriminatory recommendations for all users and reduces bias occurrence. The system supports multiple languages therefore a wider range of users can obtain career understanding because it serves individuals without English proficiency. AI technology needs to use NLP state-of-the-art models and interactive mentorship capabilities to provide virtual career advice to users through an AI system. The virtual advisors deliver complete field explanations through interactive guidance sessions with direct answers to client inquiries. Users through the system can explore appropriate careers besides building their career readiness through features that help create resumes and map out skill development directions.

REFERENCES

- Barbadekar, A., Bhagwan, V., Thaploo, A., & Tyagi, A. (2024). Career Navigator: Your AI Career Counselor. 2024 2nd DMIHER International Conference on Artificial Intelligence in Healthcare, Education and Industry (IDICAIEI), Wardha, India, pp. 1-6. IEEE.
- [2] Patil, S., Rathi, S., Shewale, C., Bodakhe, S., Dusane, C., & Bhoye, N. (2024). AI-based career counseling chatbot for secondary-level students. In Artificial Intelligence Applications for Career Development (pp. 201–220). IGI Global.
- [3] Kamal, A., Naushad, B., Rafiq, H., & Tahzeeb, S.

(2021). Smart Career Guidance System. 2021 4th International Conference on Computing & Information Sciences (ICCIS), Karachi, Pakistan, pp. 1-7. IEEE.

- [4] Chen, J. (2024). Construction of career planning and employment guidance system for college students. Applied Mathematics and Nonlinear Sciences, 9.
- [5] Herath, A., Kumara, B., Ishanka, P., & Rathnayaka, R. M. K. (2024). Computer-assisted career guidance tools for students' career path planning: A review on enabling technologies and applications. Journal of Information Technology Education: Research, 23.
- [6] Al Zakwani, A., Thuwarakesh, D., & Khalil, M. K. (2024). Enhancing academic guidance with AI:Investigating the present capabilities and future prospects of ChatGPT in empowering students. In Academic Guidance Using Artificial Intelligence (pp. 175–188). CRC Press.
- [7] Nuttall, B. (2024). Green career education and guidance through the perceptions and experiences of career practitioners in English secondary schools. Journal of the National Institute for Career Education and Counselling, 53, 105–121.
- [8] Singh, A., Sharma, H., Jindal, K., & Chaudhary, A. (2024). Synergizing Futures: Precision Career Mapping with Llama 2 and AI Fine-Tuning for Personalized Path Prediction and Guided Navigation. 2024 International Conference on Communication, Computer Sciences and Engineering (IC3SE), Gautam Buddha Nagar, India, pp. 336-341. IEEE.
- [9] V., Vaishnavalakshmi. (2024). Recruiting revolution: How AI is streamlining hiring. Shanlax International Journal of Management, 11(S1), 63– 70.
- [10] Cioffi, V., Ragozzino, O., Mosca, L., & Moretto,E. (2024). Can AI technologies support be automating clinical supervision? Assessing the potential of ChatGPT. Preprints, 2024.
- [11] Vignesh, S., Priyanka, C. S., Manju, H. S., & Mythili, K. (2021). An Intelligent Career Guidance System using Machine Learning. 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, pp. 987-990. IEEE.
- [12] A. Kamal, B. Naushad, H. Rafiq, and S. Tahzeeb,"Smart Career Guidance System," 2021 4th

International Conference on Computing & Information Sciences (ICCIS), Karachi, Pakistan, 2021, pp. 1-7,

- [13] S. Vignesh, C. Shivani Priyanka, H. Shree Manju, and K. Mythili, "An Intelligent Career Guidance System using Machine Learning," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 987-990
- [14] R. Sucharitha, A. Duhan, H. Singh, J. Singh, S. Kadyan, and M. Kaur, "Online Career Guidance and Counseling - Picxida," 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), Noida, India, 2021, pp. 1-5
- [15] Sucharitha, R., Duhan, A., Singh, H., Singh, J., Kadyan, S., & Kaur, M. (2021). Online Career Guidance and Counseling - Picxida. 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), Noida, India, pp. 1-5. IEEE.