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PATHWAY : PERSONALIZED AI-BASED CAREER GUIDANCE PLATFORM

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ABSTRACT : Career planning today demands intelligent and personalized guidance as job markets evolve rapidly. This paper presents Pathway: AI Career Coach, an AI-powered web platform that offers tailored career recommendations, resume and cover letter generation, mock interview simulations, and industry insights. Built using Gemini 2.5 API with a modern full-stack framework (Next.js, Prisma ORM, Clerk, and NeonDB), the system provides context-aware guidance while maintaining scalability and data security.

The solution addresses the gap in accessible, data-driven career support by automating essential processes and delivering personalized, real-time feedback to users. Results indicate that integrating generative AI with modern web systems enhances employability and user confidence in decision-making.

In conclusion, the AI Career Coach redefines digital career counseling by merging artificial intelligence and full-stack technologies to provide affordable, adaptive, and scalable guidance for learners and professionals alike.

Keywords — Artificial Intelligence, Career Coaching, Generative AI, Large Language Models, Gemini API, Resume Generation, Interview Simulation, Personalized Career Guidance.

I. INTRODUCTION

Career planning and professional development have become increasingly complex in the evolving digital economy. Students and early-career professionals often face uncertainty when selecting appropriate career paths due to limited access to personalized guidance and mentorship. Studies indicate that only a small proportion of graduates receive meaningful career counseling, despite the growing demand for skill-based employability and informed decision-making. Meanwhile, recent advancements in artificial intelligence (AI) have demonstrated significant potential in transforming the career advisory domain. Notably, Google's *Career Dreamer* employs AI-driven skill mapping to suggest career trajectories, and LinkedIn Learning integrates conversational AI to offer real-time learning recommendations and professional insights.

To address these challenges, this paper presents **Full Stack AI Career Coach**, an intelligent, web-based platform designed to function as a virtual career advisor. The proposed system enables users to input academic and professional information—including skills, education, and experience—and subsequently receive tailored recommendations for career advancement. The platform provides multiple integrated modules such as **AI-powered resume and cover letter generation**, **AI-driven interview simulation with feedback**, and **industry insights dashboards** for data-backed decision-making. These features collectively enhance employability and readiness for job markets.

The system leverages **Google's Gemini 2.5 API** to generate context-aware, human-like responses that adapt to user profiles and evolving labor market trends. On the backend, a robust full-stack architecture is implemented using **Next.js** for frontend rendering, **Prisma ORM** with **NeonDB** for efficient data management, and **Clerk** for secure authentication. **Inngest** is integrated to automate background processing and ensure scalability in handling concurrent AI-driven tasks.

The major contributions of this research are as follows:

1. **AI-Powered Career Guidance:** Integration of the Gemini 2.5 API to generate adaptive and contextually relevant recommendations for career paths, skills, and job readiness.

2. **Full-Stack Architecture:** Development of a scalable and responsive system using Next.js, Prisma ORM, NeonDB, and Inngest for efficient performance and real-time data handling.

3. **Automated Career Tools:** Implementation of AI modules for **resume and cover letter generation**, **AI mock interview simulation**, and **interactive industry insight dashboards**.

4. **Societal Impact:** Democratization of access to intelligent career guidance tools, reducing cost and geographic limitations associated with traditional counseling systems .

II. LITERATURE REVIEW

Researchers have extensively explored the role of **Generative AI (GenAI)**, **Large Language Models (LLMs)**, and **machine learning (ML)** in education, recruitment, and career guidance. Collectively, studies indicate that multimodal AI systems such as **Google Gemini** and **GPT-based models** can revolutionize career development by offering scalable, personalized, and data-driven coaching.

Sr. No.	Title of Paper	Authors / Year	Key Findings	Limitations
1	*Envisioning Tomorrow: AI Powered Career Counseling*	M. S. Ghuge et al., ICIMIA 2023	• ML-based career guidance using KNN & SVM. • Automates early-stage counseling.	• Small dataset. • Few psychometric factors. • No long-term validation.
2	*Designing an AI-Powered Mentorship Platform*	R. Bagai et al., IJCTT 2023	• NLP-based mentor–mentee matching. • Highlights scalability and feedback automation.	• Conceptual only. • Ethical issues untested.
3	*Generative AI in Engineering and Computing Education*	J. Á. Ariza et al., IEEE Access 2024	• Reviewed 146 studies on GenAI in STEM. • Proposed AI-literacy curriculum.	• Mixed evidence. • Few long-term studies.
4	*Google Gemini as a Next-Gen AI Educational Tool*	M. Imran et al., SLE 2024	• Gemini enables multimodal learning & inclusivity.	• Fairness & bias untested. • Regulatory gaps.
5	*Gemini – The Most Powerful LLM: Myth or Truth*	R. Islam et al., ICICET 2024	• Benchmarked Gemini vs. GPT-4; superior in comprehension.	• Early data only. • Reproducibility issues.
6	*AI-Powered Resume Screening: Benefits & Challenges*	Multi-author, IEEE/Springer 2023	• LLM-based parsing improves hiring speed & accuracy.	• Bias & opacity. • Poor visual resume handling.

7	*Ethics and Discrimination in AI Recruitment*	R. L. Moore et al., JBE 2024	• Highlights bias and audit trail needs.	• Conceptual; cost of fairness ignored.
8	*Explainable AI in Talent Recruitment*	G. Zhang et al., CBM 2025	• Reviews SHAP/LIME for explainable HR AI.	• High compute cost. • Limited transferability.
9	*LLMs in Education – Current Trends*	H. Shang, EdTech 2024	• Explores LLMs for tutoring & personalization.	• Short-lived insights; rapid evolution.
10	*The Digital Divide in Action*	C. Benton et al., AI & Society 2024	• Analyzes how access & literacy shape AI use.	• Region-specific • No technical remedies.

Research Gaps

1. Limited Multimodal and Personalized Integration : Most prior systems rely solely on textual or structured data for recommendations. Few incorporate multimodal elements (e.g., portfolio visuals or scanned resumes) or dynamic personalization through adaptive AI models.

2. Lack of Real-Time and Scalable Architectures : Existing studies focus on standalone models or small datasets without addressing large-scale, real-time deployment challenges for thousands of concurrent users.

3. Bias, Transparency, and Explainability Deficiencies : Despite advances in LLMs, most systems fail to integrate fairness auditing, bias detection, or interpretable feedback mechanisms to build trust among diverse users.

4. Neglect of Accessibility and Rural Inclusion : Few solutions consider low-bandwidth operation, offline support, or multilingual interfaces, leading to continued digital divide between rural and urban learners.

5. Data Privacy and Security Oversight : Prior research often neglects explicit consent handling, encryption protocols, or secure authentication mechanisms necessary for protecting user career data.

6. Limited Longitudinal Evaluation and User Adaptation : Most implementations are conceptual or short-term studies; long-term validation of career outcomes and continuous model retraining based on evolving job markets remain largely unexplored.

.III. PROPOSED SYSTEM

The **Full Stack AI Career Coach** is designed as a scalable, cloud-based platform that integrates advanced artificial intelligence with a modern full-stack web framework to deliver personalized career guidance. The proposed system aims to provide users with AI-driven resume generation, interview preparation, and career counseling through a unified and interactive web interface.

3.1 System Overview

The system architecture, illustrated in *Fig. 1*, consists of four major layers: **Client Side**, **Server Side**, **External Services**, and **Database & ORM Layer**. Each layer is responsible for handling a distinct set of functionalities, ensuring modularity, scalability, and secure data exchange.

1. **Client Side :** The front-end interface is built using **Next.js 15** and **React 19**, providing users with a responsive and intuitive experience. The client interacts with the system through various modules, including AI chatbot, resume and cover letter generators, and the interview preparation dashboard. User authentication is handled via the **Clerk SDK**, which securely manages sign-up, login, and session persistence.

2. **Server Side :** The backend utilizes **Next.js API Routes** and **Node.js controllers** to manage business logic and process client requests. Incoming API calls from the client are routed to the appropriate service layer for data handling, AI response generation, or file management. The system employs **Prisma ORM**

for structured interaction with the database, enabling efficient read/write operations while maintaining data integrity.

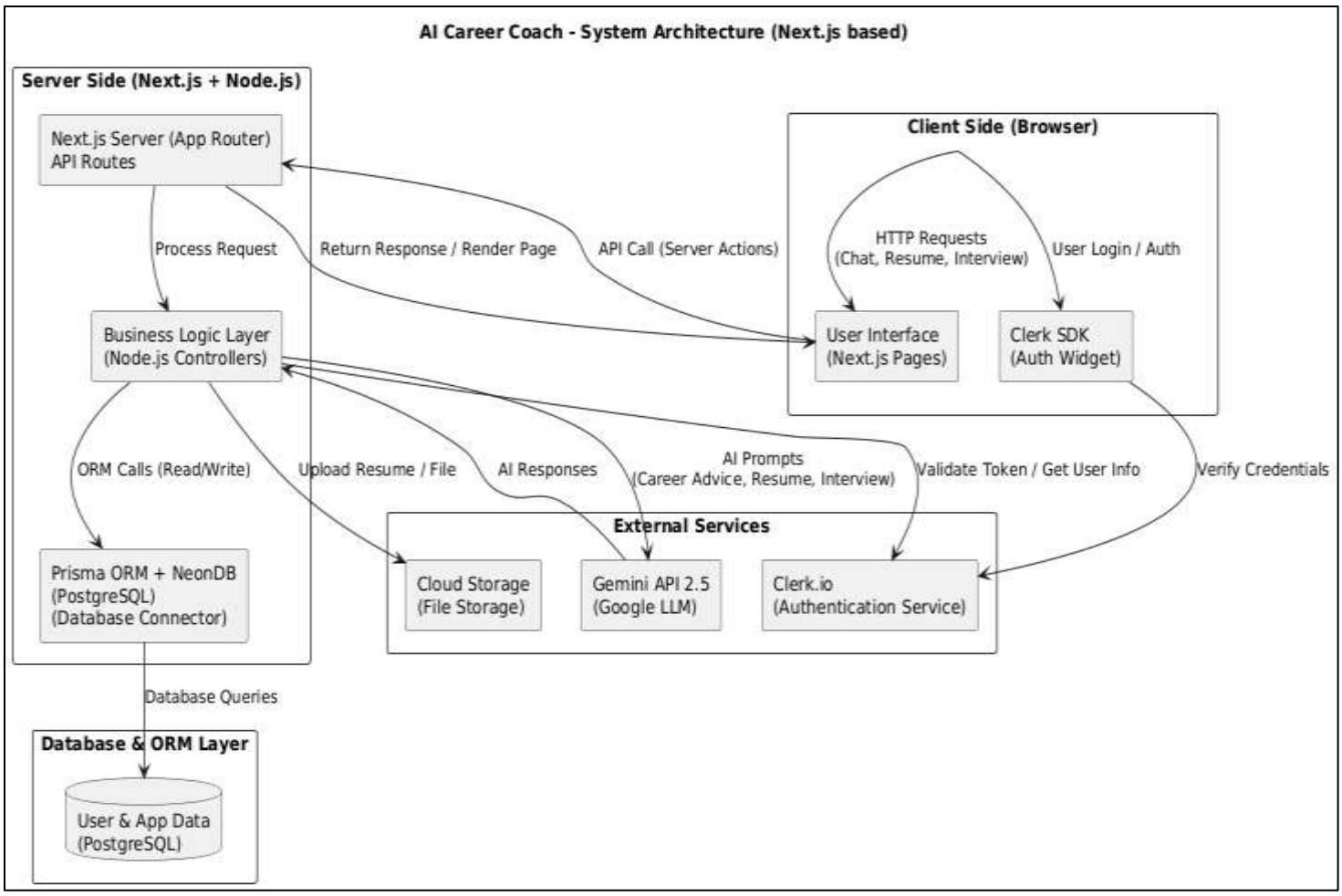

Fig. 1. *System architecture of the AI Career Coach showing interactions between client, server, external services, and database layers.*

3. **External Services :** The system integrates with multiple external services to enhance performance and intelligence. The **Gemini 2.5 API** serves as the core large language model, generating contextual and human-like responses for resume optimization, interview simulations, and career recommendations. **Clerk.io** handles authentication verification, ensuring that user sessions are secure and tokens are validated before backend processing. For file storage, services like **AWS S3** or **Cloudinary** are used to store generated resumes and cover letters, while only metadata and file URLs are persisted in the primary database.

4. **Database and ORM Layer:** Data persistence is achieved using **NeonDB**, a serverless PostgreSQL-based database optimized for scalability and developer efficiency. The **Prisma ORM** acts as the data access layer, mapping application entities such as users, resumes, and interview sessions to relational database models. This design ensures reliable, high-performance data operations across all modules.

The **System Architecture Diagram** (**Fig. 1**) illustrates the interaction between client-side components, server-side business logic, external services (Gemini API, Clerk.io, and Cloud Storage), and the database & ORM layer (Prisma ORM with NeonDB)

3.2 Methodology

The methodology of the *AI Career Coach* system is designed to establish a scalable, AI-driven full-stack platform that assists users in their career development journey through intelligent automation and contextual personalization. The system integrates advanced technologies such as **Gemini 2.5 API**, **Next.js**, **Prisma ORM**, **Clerk**, and **NeonDB** to deliver end-to-end functionality.

A. System Workflow Overview

The workflow is modular and event-driven, following a client–server architecture optimized for scalability and responsiveness. The process can be summarized as follows:

1. **User Authentication:** Users register and log in through **Clerk**, which issues secure authentication tokens to control access.

2. **Frontend Interaction:** The user engages with the interface built using **Next.js 15** and **React 19**, initiating actions such as resume generation, AI interview practice, or chatbot consultations.

3. **Backend Request Handling:** All user actions trigger API calls routed to the backend (Next.js API Routes), where tokens are verified, and relevant services are called.

4. **Database Operations:** The backend interacts with **NeonDB** (via **Prisma ORM**) to read or update user data, such as profiles, resumes, or AI chat history.

5. **AI Integration:** The **Gemini 2.5 API** processes natural language prompts to generate tailored outputs—resumes, cover letters, or interview feedback.

6. **Response Rendering:** The generated responses are sent back to the frontend, formatted for display, and optionally stored for later access.

B. Use Case Representation

The system supports multiple functional modules, all driven by user interactions. The **Use Case Diagram (Fig. 2)** illustrates the major functionalities and actors involved in the *AI Career Coach* system.

Explanation:
The system supports two main actors — **User** and **Admin**.

- The **User** can authenticate via Clerk, generate AI-driven resumes and cover letters, engage in mock interviews, consult the AI chatbot for career guidance, and access an interactive industry insights dashboard.
- The **Admin** manages user activity, system monitoring, and data integrity. This structure ensures usability and administrative control within a unified architecture.

C. Sequence of Operations

The detailed sequence of system interactions is shown in **Fig. 3**, illustrating communication between the frontend, backend, authentication layer, database, and AI engine.

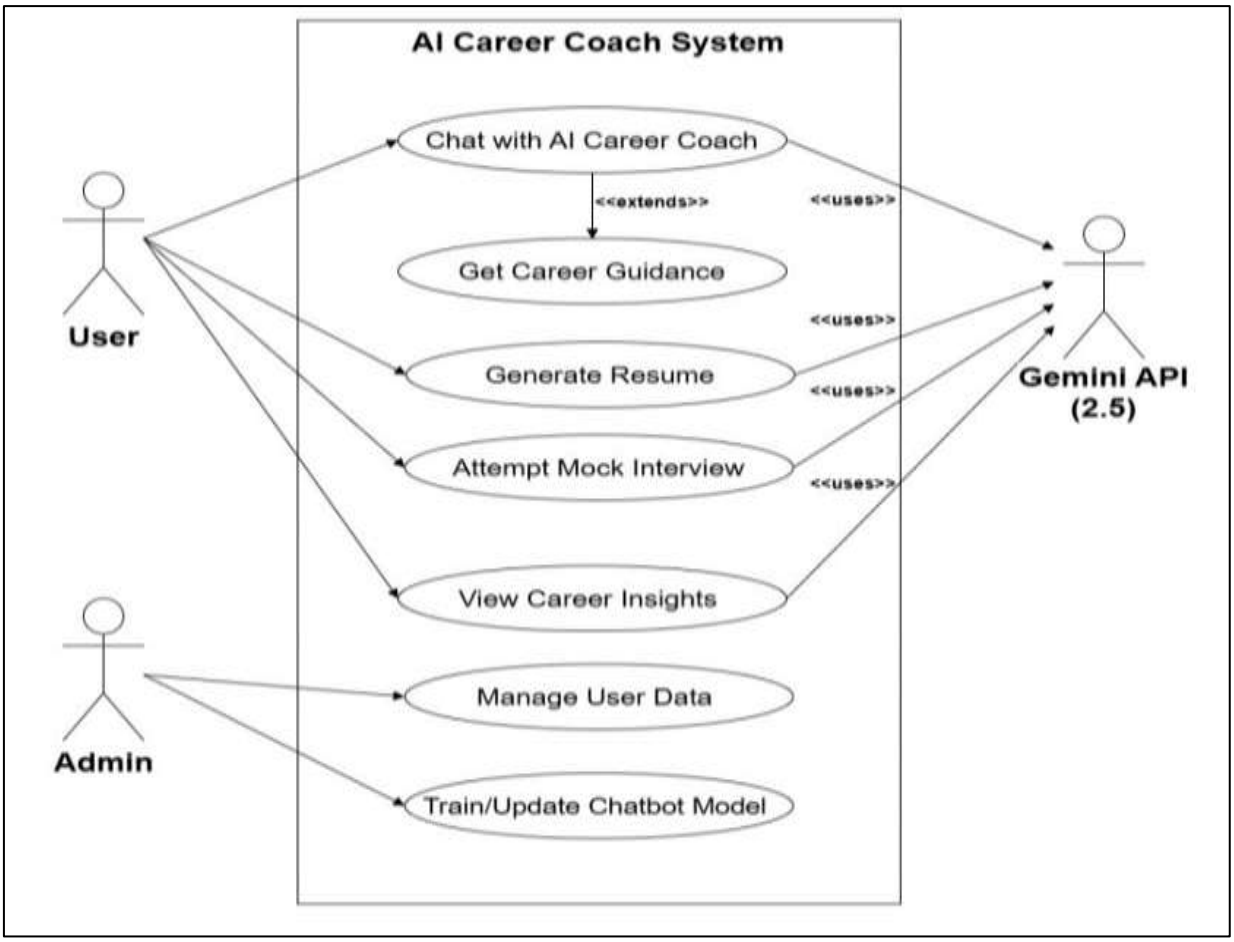

Fig. 2. Use case diagram showing primary interactions between users, admin, and system modules in the AI Career Coach platform.

D. Workflow Summary

The *AI Career Coach* system follows a modular methodology integrating authentication, database management, and AI-powered services through a unified full-stack framework. The combination of **Gemini 2.5**, **Next.js**, and **Prisma ORM** enables secure, dynamic, and context-aware career guidance. Asynchronous processing with **Inngest** ensures that resource-intensive tasks (like resume rendering and interview simulations) are handled efficiently.

This architecture ensures scalability, reliability, and adaptability—laying the foundation for a production-ready AI-powered career guidance system.

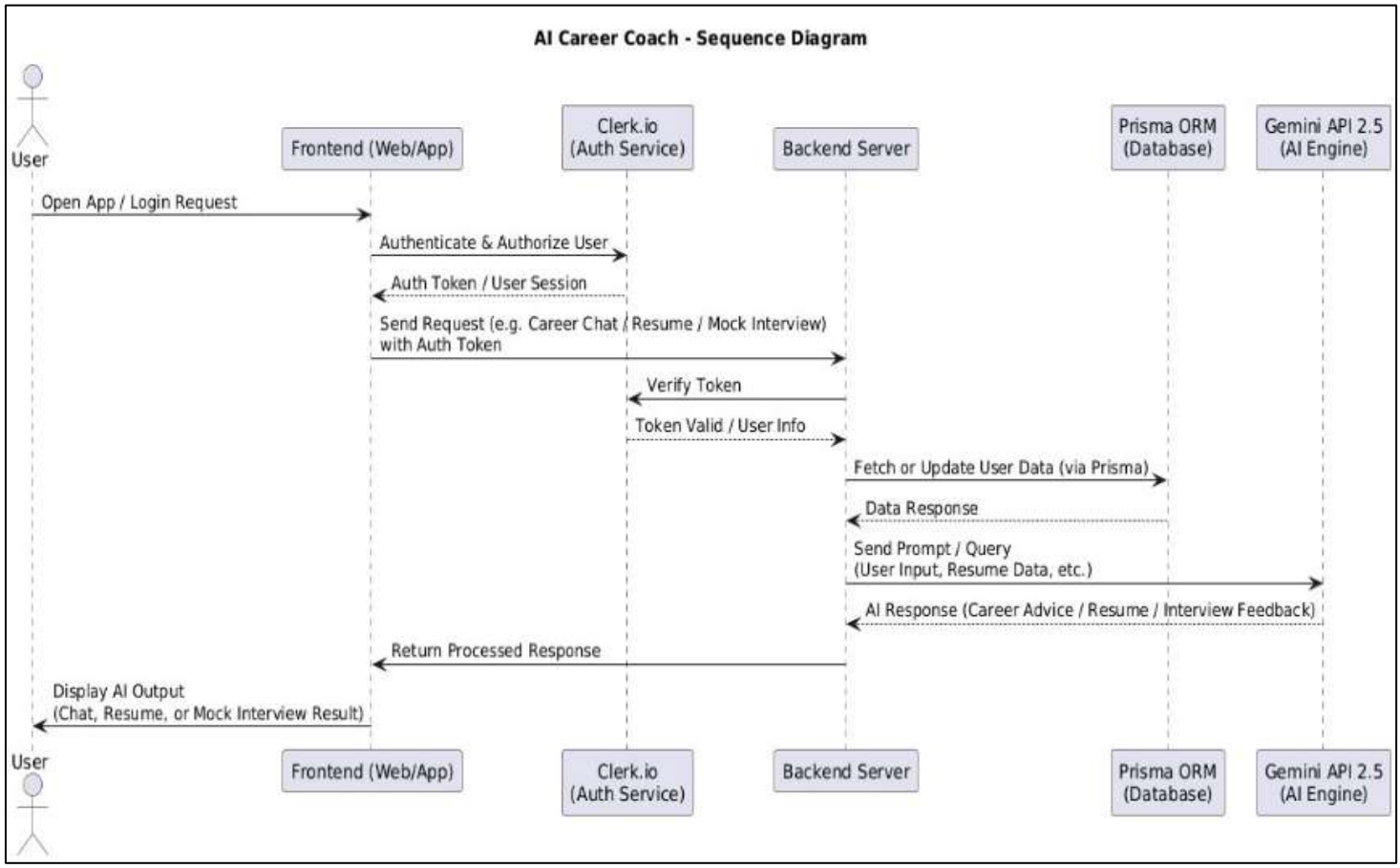

Fig. 3. Sequence diagram illustrating the request–response flow between system components during AI-powered operations.

IV. CHALLENGES AND LIMITATIONS

Despite the promising capabilities of Pathway: AI Career Coach, several challenges and limitations were identified during the development and evaluation of the system.

1. Dependence on Generative AI Accuracy : The platform relies heavily on the Gemini 2.5 API for generating career recommendations, resumes, interview questions, and feedback. While generative AI demonstrates strong contextual understanding, it may occasionally produce inaccurate, generic, or biased suggestions, particularly for niche career paths or emerging job roles. This limitation highlights the need for continuous validation and human oversight.

2. Limited Real-World Career Outcome Validation : The system's effectiveness is currently evaluated based on user interaction quality and perceived confidence improvement, rather than long-term employment outcomes such as job placement or salary growth. Measuring real-world career success requires extended longitudinal studies, which are beyond the scope of the present implementation.

3. Data Privacy and Ethical Concerns : Handling sensitive user information, including resumes, career preferences, and interview responses, introduces privacy and ethical challenges. Although secure authentication (Clerk) and database management (NeonDB) are implemented, risks related to data breaches, misuse, and compliance with global data protection regulations (e.g., GDPR) remain a concern.

4. Personalization Constraints : While the platform provides personalized guidance based on user input, it may not fully capture emotional, psychological, or socio-

economic factors that human career counselors consider. As a result, recommendations may lack the depth and empathy associated with traditional one-on-one counseling.

5. Bias in Training Data : Generative AI models are trained on large-scale datasets that may contain historical and societal biases related to gender, geography, or educational background. These biases can influence career recommendations and hiring advice, potentially reinforcing existing inequalities if not actively monitored and mitigated.

6. Scalability and Cost Challenges : Although the platform is designed to be scalable using modern cloud-based infrastructure, API usage costs and computational resources may increase significantly with a growing user base. Sustaining affordability while maintaining performance and responsiveness is a key operational challenge.

7. Dynamic Job Market Adaptation : The job market evolves rapidly, with new roles, skills, and technologies emerging frequently. Ensuring that the AI Career Coach remains up-to-date with industry trends requires continuous data integration and model updates, which can be resource-intensive.

V. CONCLUSION AND FUTURE WORK

The *AI Career Coach* represents an effort to merge artificial intelligence with modern full-stack web technologies to provide personalized, efficient, and scalable career support. By automating core aspects of career preparation—resume writing, cover letter drafting, mock interviews, and real-time career counseling—the platform addresses key challenges faced by students and early professionals who lack access to one-on-one guidance.

From a technical standpoint, the integration of **Gemini 2.5 API** with **Next.js**, **Prisma**, and **NeonDB** establishes a robust foundation for future enhancements. The modular design ensures adaptability, allowing for additional AI-driven functionalities such as recruiter-style evaluations or portfolio optimization.

Future work will focus on expanding the system's intelligence and inclusivity. Planned improvements include:

- **Multilingual and regional support** to reach a broader user base.
- **Integration of live recruiter feedback loops** for more realistic assessment.
- **Advanced analytics** to track user progress and recommend skill-learning paths.
- **Model fine-tuning** to adapt AI suggestions for specific industries and domains.

In conclusion, the proposed system has the potential to bridge the existing gap between career aspirations and practical preparation by offering an accessible, AI-augmented platform that empowers users to navigate their career journeys confidently and efficiently

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