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Personalized Career Guidance System Based on AI and Skill Gap Assessment

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***Abstract*—The AI-Based Career Recommendation System is an innovative digital platform developed to assist students and professionals in selecting suitable career paths based on their skills, interests, academic background, and career preferences. The system aims to simplify career guidance and improve decision-making by providing an intelligent environment where users can analyze their technical skills, explore career opportunities, receive personalized recommendations, and identify the skills required for professional growth. The platform addresses a major challenge faced by many students: lack of proper career guidance and limited awareness about industry requirements and emerging technologies. By integrating Artificial Intelligence and Machine Learning techniques into the recommendation process, the system provides a structured, transparent, and user-friendly solution that helps users make informed career decisions without confusion or uncertainty. The system is developed using React.js for the front-end interface and Supabase for the backend database, while Spring Boot is used for backend services, ensuring efficiency, scalability, and secure data storage. Each user is provided with a personalized dashboard containing customized features such as career recommendations, skill-gap analysis, learning roadmaps, quizzes, and progress tracking modules. The modern UI design, enhanced with responsive layouts and simple navigation, ensures accessibility and ease of use for all users. The system not only facilitates intelligent career prediction but also supports continuous learning and skill development through certification recommendations, practice modules, and learning resources. By improving awareness, reducing career uncertainty, and helping users align their skills with industry demands, the platform contributes significantly toward digital learning and career empowerment. This project demonstrates how Artificial Intelligence can be effectively leveraged to transform traditional career guidance systems into a more adaptive, efficient, and user-centric model.**

***Index Terms*—AI-Based Career Recommendation System, Artificial Intelligence, Machine Learning, Skill Gap Analysis, React.js, Spring Boot, Supabase, Career Guidance, Personalized Learning, Recommendation System, Career Prediction, Educational Technology**

I. INTRODUCTION

In an era of rapid digital transformation, where Artificial Intelligence and data-driven technologies are revolutionizing industries such as healthcare, education, and finance [1], career guidance systems still remain limited in personalization and accessibility. Many students and professionals face significant difficulties while selecting suitable career paths due to lack of proper guidance [2], insufficient awareness about industry requirements, and limited understanding of emerging technologies and skill demands. This creates a major gap between an individual's capabilities and the opportunities available in the modern job market, often resulting in confusion, poor decision-making, and reduced employability.

Students frequently depend on traditional career counseling methods, peer suggestions, or generalized online resources that fail to analyze individual strengths, technical competencies, and career interests effectively. Existing recommendation platforms often provide static or generic suggestions without considering important factors such as technical skills, certifications [3], academic performance, interests, and current industry trends. As a result, many individuals struggle to identify suitable career opportunities and required learning paths, especially in rapidly evolving domains such as Artificial Intelligence, Data Science, Cloud Computing, Cyber Security, and Web Development [4].

The AI-Based Career Recommendation System has been developed to address these challenges [5]. It is an intelligent career guidance and learning support platform that assists students and professionals in identifying suitable career domains based on their skills, interests, academic background, and career preferences. The primary aim of the project is to simplify career decision-making, improve career awareness,

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and provide personalized recommendations through Artificial Intelligence and Machine Learning techniques. The platform provides a user-friendly environment where individuals can analyze their technical profiles, explore career opportunities, identify skill gaps, and access personalized learning resources for professional growth.

Developed using React.js for the front-end interface and Supabase for the backend database, while Spring Boot is used for backend services, the system offers a responsive user interface and a scalable data management architecture. React.js was chosen for its ability to deliver responsive and interactive web applications, while Supabase ensures efficient data handling and secure cloud-based storage [2]. The system architecture uses a modular design, providing personalized dashboards and customized features for users. This structured approach ensures smooth interaction between recommendation modules, learning resources, backend services, and database systems within a single coordinated framework.

The AI-Based Career Recommendation System introduces a modern approach to career guidance. By enabling intelligent recommendations and digital learning support, it reduces the confusion and uncertainty associated with traditional career planning methods. The platform functions as both a recommendation and educational tool, helping users identify suitable career opportunities while also guiding them toward the required technical skills, certifications, and learning resources.

The motivation for this project stems from the increasing difficulty students face while selecting career paths in rapidly evolving technological domains. This project aims to solve that challenge by creating an adaptive, modern, and reliable platform. It supports key functionalities such as career recommendations, skill-gap analysis, quizzes, learning roadmap generation, and progress tracking, all interconnected for a smooth workflow. From a technical standpoint, the project prioritizes security, usability, and maintainability. User data is protected, the interface is designed for users of different technical backgrounds, and the modular system architecture supports future scalability.

I. LITERATURE REVIEW

The rapid growth of Artificial Intelligence and Machine Learning technologies has significantly transformed the field of career guidance and recommendation systems. Traditional career counseling methods often fail to provide personalized and data-driven guidance according to individual skills, interests, and industry requirements. Researchers have proposed various intelligent recommendation frameworks that utilize machine learning, data analysis, and user profiling techniques to improve career decision-making processes. This section reviews existing literature related to career recommendation systems, personalized learning systems, and AI-driven educational technologies, highlighting their methodologies, contributions, and limitations.

A. Career Recommendation Based on Feature Selection

Several researchers have proposed machine learning-based career recommendation systems using feature selection and classification algorithms to improve recommendation accuracy. Existing studies evaluate algorithms such as K-Nearest Neighbors (KNN), Naive Bayes (NB), Random Forest (RF), Decision Tree (DT), Support Vector Machine (SVM), and Gradient Boosting (GB) for predicting suitable career paths. Among these techniques, Random Forest demonstrated higher accuracy because of its ability to handle complex datasets and multiple career-related attributes. These systems mainly focus on academic and technical features but are often limited to specific domains and lack adaptability across broader career sectors.

B. Career Recommendation Based on Feature Selection

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C. Job and Career Recommendation Systems

Recent studies on job and career recommendation systems provide comprehensive analysis of recommendation models, evaluation strategies, and hybrid filtering techniques. Many systems combine collaborative filtering, content-based filtering, and skill-based matching to improve recommendation [8]. These studies highlight the importance of integrating user preferences, job requirements, and skill analysis into recommendation frameworks. However, most systems focus only on job matching and fail to provide continuous learning support or personalized career development guidance.

D. Skill Gap Analysis and Person–Job Fit Models

Several research works focus on skill extraction, person–job fit analysis, and competency matching modeles [2], [9]. These systems analyze user skills and compare them with industry requirements to identify missing competencies. Skill-aware recommendation approaches help users understand the gap

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between their current profile and target job roles [9] Although these systems improve recommendation relevance, many lack personalized learning support and real-time adaptability to changing industry trends.

E. Personalized Learning Recommendation Systems

Personalized Learning Recommendation systems play an important role in modern educational technology platforms [3] Existing studies analyze learner modeling methods, recommendation algorithms, and adaptive learning techniques using Artificial Intelligence. These systems use content-based filtering, collaborative filtering, ontology-based learning, and deep learning approaches such as Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks [10] The major challenges identified include poor adaptability, privacy concerns, cold-start problems, and limited explainability of recommendations.

F. Personalized Career-Path Recommender Systems

Several researchers have proposed Personalized Career-Path Recommender Systems that simulate human career counseling using fuzzy logic and AI-based analysis [10] These systems evaluate academic performance, personality traits, extracurricular activities, and interests to recommend suitable career domains. Fuzzy logic-based systems are effective for handling uncertainty in user profiles and recommendation criteria. However, these systems often suffer from limited scalability, low evaluation reliability, and lack of integration with modern AI learning frameworks.

G. Retrieval-Augmented Generation and Intelligent Recom-mendation

Recent advancements in Retrieval-Augmented Genera-tion frameworks [12] improve recommendation quality and context-aware response generation. These systems combine retrieval-based models with Large Language Models to generate accurate and reliable recommendations. Retrieval-Augmented approaches improve contextual understanding, reduce hallucinations, and enhance information retrieval performance. However, these systems require large datasets, high computational resources, and structured knowledge repositories for effective implementation.

II. PROBLEM STATEMENT

Career selection remains a critical and persistent challenge for students and professionals, creating a significant gap between individual capabilities and industry requirements. This problem is not limited to lack of opportunities but is fundamentally caused by the fragmented and non-personalized nature of existing career guidance systems.

Currently, the career guidance ecosystem is composed of disconnected resources and generic recommendation platforms. A student or professional seeking career guidance is often exposed to scattered information from online articles, social media, aptitude tests, learning platforms, and career portals that operate independently [4] .[5]. There is no unified system capable of intelligently analyzing technical skills, interests, academic performance, certifications, and industry demands together within a single platform.

This fragmented environment places a major burden on users, especially students who lack proper mentorship and industry awareness. They are forced to search through multiple platforms, compare inconsistent recommendations, and identify required skills on their own, resulting in confusion, poor career decisions, wasted learning efforts, and reduced employability.

While career recommendation platforms and educational portals already exist, they fail to address the problem of integrated and personalized career guidance. Existing systems are either (1) static recommendation portals providing generalized suggestions or (2) isolated learning platforms that focus only on courses without intelligent career analysis and skill-gap identification [8] ,[9]. Therefore, there is a clear need for a unified, adaptive, and user-centric platform capable of bridging this gap.

III. SYSTEM DESIGN AND METHODOLOGY

The AI-Based Career Recommendation System was de-signed and implemented using a structured, stepwise method-ology to ensure scalability, security, and usability. The de-velopment process followed a systematic approach from re-quirement gathering to deployment and evaluation. The system architecture is based on a three-tier design (presentation, business logic, data) to ensure modularity and maintainability [13]

A. System Overview

- The AI-Based Career Recommendation System is a uni-fied platform connecting students, professionals, learning resources, and recommendation modules to provide personalized career guidance and skill development.
- The system uses a modular client-server architecture, with dedicated interfaces for recommendation generation, skill-gap analysis, quizzes, and learning roadmaps.
- The technologies used include React.js (front-end), Spring Boot (logic), and Supabase (database).
- Core objectives include high usability, intelligent recommendation generation, scalability, and efficient data management.

B. System Architecture

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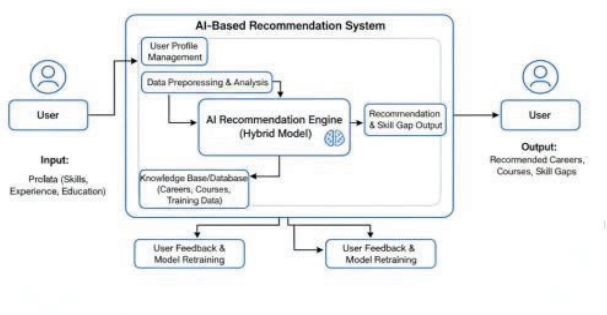

Fig. 1. System Architecture

- The Presentation Layer handles user interactions. Re-act.js interfaces provide personalized dashboards for rec-ommendations, quizzes, skill-gap analysis, and learning progress.
- The Business Logic Layer manages system operations. Controllers handle user actions (login, recommendation generation, quiz evaluation, roadmap generation), with integrated validation and error handling.
- The Data Layer (Supabase) stores structured data. Tables are normalized (3NF) to minimize redundancy and ensure relational integrity .[5].
- The backend communication uses REST APIs, with se-cure authentication mechanisms to prevent unauthorized access.
- Fig. 1 illustrates the system architecture, layer interaction, and data flow.

C. Methodology

- The methodology began with Requirement Analysis, identifying functional (e.g., user registration, career rec-ommendation, quiz evaluation) and non-functional re-quirements.
- In the System Design phase, DFDs, ER diagrams, and workflow models were prepared, and the database schema was finalized.
- During Implementation, React.js interfaces were built for user interaction, and Spring Boot logic was coded using the MVC pattern.
- Database connectivity was implemented via REST APIs, with user input validation for integrity [6]
- The Testing phase included unit, integration, and usability testing. Security testing validated data confidentiality and access control.
- Deployment involved configuring the Supabase database and deploying the application with secured credentials.
- The Evaluation and Maintenance phase focused on per-formance analysis, user feedback, and log monitoring for future improvements.

D. Workflow of the System

- Users register via a secure authentication module and access a customized dashboard based on their profile.
- Users submit skills, interests, and academic details, trig-gering recommendations and skill-gap analysis based on user data.
- The recommendation engine generates career paths, matching percentages, and learning roadmaps for selected domains [7].
- Users can access quizzes, certifications, and learning resources, while administrators can manage datasets and updates.
- Completed assessments are stored and analyzed. Users provide feedback, and reports are generated for adminis-trative review.

E. Validation and Evaluation

- Functional validation verified that all modules met the requirements specified in the SRS document.
- Usability testing confirmed the UI's ease of use, intuitive navigation, clarity, and performance.
- Security validation ensured proper implementation of role-based access control, password encryption, and SQL protection.
- Performance metrics (e.g.. response time, data retrieval speed) were analyzed to confirm the system's ability to handle concurrent requests.
- The system was continuously monitored, with mainte-nance procedures established for regular updates and database backups.

IV. EXPERIMENTATION AND IMPLEMENTATION

A. Implementation Process

- The implementation began with the creation of the project environment and initial configuration. React.js, Spring Boot, and required dependencies were installed and configured with the chosen IDEs (VS Code and IntelliJ IDEA). The Supabase database was initialized with schema definitions including tables for users, rec-ommendations, quizzes, learning resources, and progress tracking.
- The database connectivity was established using REST APIs. A separate configuration layer was implemented to manage API endpoints, authentication, and data ex-change. Secure API requests were used instead of direct database queries to enhance security during data manip-ulation.
- The frontend design was created using React.js compo-nents. Each interface—such as Login, Registration, Dash-board, and Recommendation Module—was designed us-ing CSS for consistent color schemes and styling. The layout followed a modern user interface pattern with rounded corners, drop shadows, and a deep blue theme (#2F3C7E) for visual consistency across all modules.

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- The controller layer handled all logic and user interactions. Event-handling methods were coded in back-end controller classes, which managed data validation, navigation, and recommendation processing. Exception handling blocks were integrated to ensure that unexpected input or system errors did not crash the application.
- Once the interface and controller integration were com-pleted, the business logic modules were implemented. This included functionalities such as user authentication, career recommendation, skill-gap analysis, quiz evalua-tion, and learning roadmap generation. The authentication process used JWT-based security mechanisms, ensuring secure access and protected user sessions.

B. The Career Recommendation Engine was developed to automatically suggest career paths to users based on their skills, interests, and academic background. The algorithm retrieved recommendation data from the database and sorted it by matching percentage, skill relevance, and career demand.

C. After the main modules were implemented, the test-ing phase began. Each feature was tested independently through unit testing, followed by integration testing to ensure seamless operation between the frontend and backend components.

D. Experimentation and Analysis

- Experimentation was conducted in a controlled environ-ment to measure the performance and reliability of the AI-Based Career Recommendation System. The testing environment consisted of a local server setup with a quad-core processor, 8 GB of RAM, and Supabase hosted locally. Various user operations—Recommendation Gen-eration, Quiz Evaluation, Skill-Gap Analysis, and Learn-ing Roadmap Access—were tested under different input scenarios to observe functional correctness and data flow efficiency.
- During initial experiments, emphasis was placed on re-sponse time measurement. The system's average response time for login and dashboard loading was recorded as 0.8 seconds, which falls within acceptable usability stan-dards. Recommendation generation operations averaged 1.2 seconds, while skill-gap analysis queries returned results in approximately 1.4 seconds.
- The database performance was evaluated by executing multiple queries simultaneously. The use of indexing and caching improved query retrieval speed by nearly 27% compared to the non-indexed version. The experimental analysis confirmed that the system could efficiently man-age up to 50 concurrent connections without significant performance degradation.
- Security testing was conducted to ensure robustness against malicious input. SQL injection, cross-site script-ing (XSS), and brute-force attacks were simulated. Due to parameterized queries and secure authentication mech-anisms, all security tests were successfully passed.
- The usability experiment involved a group of 15 users including engineering students and professionals. They were asked to navigate through the system and perform basic tasks such as registration, recommendation gen-eration, and quiz participation. Post-experiment surveys rated the user interface with an average satisfaction score of 4.6 out of 5.
- The Learning Roadmap module was tested to verify its ability to recommend courses, certifications, and learning resources. The testing confirmed that uploaded learning materials were stored securely in the database and could be accessed dynamically by end-users.
- The Recommendation Engine module was evaluated based on recommendation accuracy and retrieval speed. Experiments demonstrated that newly updated recom-mendation data appeared immediately across all user dashboards, validating the real-time update mechanism.
- The progress-tracking module was analyzed under multi-ple update scenarios to verify data consistency. Whenever users completed quizzes or learning tasks, the correspond-ing dashboard reflected changes without manual refresh, thanks to the background update process integrated dur-ing implementation.
- To ensure proper synchronization, multi-threading was applied in sections involving background data fetching and updates. This reduced lag in real-time data presen-tation, maintaining UI responsiveness even during heavy query operations.
- Experimental analysis on concurrency showed that the system maintained stable behavior up to 50 active ses-sions. Memory usage peaked at 64% capacity, and garbage collection ensured that no memory leaks oc-curred during extended operations.

V. RESULTS AND DISCUSSION

The AI-Based Career Recommendation System's imple-mentation and experimentation yielded positive results. The primary outcome is a functional, intelligent, web-based plat-form that successfully integrates recommendation generation, skill-gap analysis, quizzes, and learning resources into a uni-fied system. Functional validation (User Acceptance Testing) confirmed all core system requirements were met.

A. Successful Implementation of Authentication and User Management

The authentication module is fully functional.

- Valid users were correctly authenticated and redirected to their respective dashboards (e.g., Recommendation Dashboard, Learning Dashboard).
- Invalid users were denied access with an "Invalid creden-tials" error alert.

This confirms the system's robust foundational security and

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user-management logic, successfully handling different user operations.

B. Proven Data Integration and Recommendation Function-ality

This is the most critical result. Test cases validating the core recommendation concept passed.

- The system successfully accepted and persisted new user profiles to the SQLite database.
- The ”Career Recommendation” module worked as ex-pected, with searches correctly querying the recommen-dation tables and the dashboard displaying matching career results.
- Similarly, the ”Learning Roadmap” and ”Quiz Mod-ule” screens correctly fetched and displayed all relevant records.

This provides a conclusive, functional proof-of-concept. The prototype acts as an intelligent recommendation platform, demonstrating a single application can connect user skills, career paths, and learning resources within one unified system.

C. System Performance and Responsiveness

The lightweight technology stack was validated by system performance.

Quantit:ative Performance
Database queries on the test database (100 records) were fast, measured at less than 150ms from recom-mendation request to dashboard display.
Qualita:tive Performance
The React.js UI was fluid and responsive. All screen transitions, navigation, and dashboard updates were instantaneous, with no discernible lag.

This confirms the ”resource-aware” engineering philosophy was successful. A high-performance and reliable application does not, for this use case, require a highly complex architec-ture.

D. Answering the Core Problem of Career Guidance Frag-mentation

Systemic fragmentation was identified as the root cause of confusion in career planning and skill development. The AI-Based Career Recommendation System provides a direct, tangible solution. The project demonstrates the primary barrier is not a lack of learning opportunities, but a lack of a user-centric recommendation platform. The proposed system acts as that integrator. As a ”one-stop-shop,” it removes the burden of searching across multiple platforms, proving a unified architecture is effective at streamlining career guidance and skill development.

E. Bridging the ”Performance vs. Accessibility” Gap

The literature review identified a gap: Career guidance systems are either (1) high-cost, complex platforms or (2) low-tech, static recommendation portals. The AI-Based Career Recommendation System creates a new third category. The discussion is that this project validates a ”middle-ground” architecture that is both intelligent and accessible. By selecting React.js, Spring Boot, and SQLite, the project trades ”infinite scale” for ”immediate accessibility.” The sub-150ms query results prove this ”resource-aware” approach is sufficient for prototype-level deployment.

F. Validation of the Evolutionary Prototyping Model

The Evolutionary Prototyping methodology was highly ef-fective. The modular architecture allowed a clean separation of concerns, making iterative development efficient. This implies that for user-centric recommendation systems, this methodology is superior to Waterfall, as it allowed the core recommendation functionality to be built, tested, and validated from the beginning.

G. Limitations of the Current Study

The project’s limitations must be addressed. The prototype validates the concept but is production-ready.

- This is the most significant limitation. The embedded SQLite database is a single-user solution and cannot scale to thousands of concurrent users.
- Passwords were stored in plaintext. A real-world system requires industry-standard hashing (e.g., bcrypt) and se-cure session management.
- Data is static and local. The prototype lacks the APIs and client-server architecture for handling live data.
- Testing focused on functional validation (”does it work?”), not usability (”can a user understand it?”). No testing was done with the actual target demographic.

H. Future Work and Recommendations

These limitations inform future work, with this prototype serving as a foundation for ”Version 2.0.”

- The next logical step is to re-architect. A server-side application (e.g., using Spring Boot) should manage a ro-bust, centralized database (e.g., PostgreSQL) and expose a secure REST API.
- Version 2.0 must implement modern security protocols, including OAuth 2.0 for authentication, SSL/TLS, and bcrypt for hashing.
- Test the prototype with target users (students, career counselors, placement staff) to gather critical UI/UX feedback.
- With a robust backend, an AI/ML component could be added to analyze user skills and recommend suitable career domains and learning paths.

In conclusion, the AI-Based Career Recommendation System successfully achieved its objective. It designed, built, and validated a functional prototype that solves career guidance fragmentation by integrating recommendation systems, learn-ing resources, and skill-gap analysis into one unified platform.

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VI. CONCLUSION

This project successfully addressed the critical problem of fragmentation within career guidance and recommendation systems. The central objective was to design, implement, and validate an intelligent platform capable of connecting users, recommendation modules, learning resources, and skill-gap analysis within a unified system [3] ,[10]

The outcome of this project is a functional, high-fidelity prototype that successfully achieves this objective. Through a resource-aware engineering approach utilizing React.js, Spring Boot, and an embedded SQLite database, the AI-Based Career Recommendation System was successfully built and tested. The experimentation results confirm that the system meets all its core functional requirements. It provides a unified and highly responsive platform where users can seamlessly explore career recommendations, analyze skill gaps, and access learning resources, proving that an intelligent and accessible application can effectively simplify career guidance and skill development.

The system successfully integrates recommendation generation, quiz evaluation, progress tracking, and learning roadmap modules within a single environment. The implemented architecture ensures smooth interaction between frontend components, backend services, and database systems while maintaining usability and performance. Experimental analysis demonstrated that the platform can efficiently manage multiple user requests with stable response times and reliable data processing.

The primary contribution of this work is not only recommendation generation, but also a validated architectural model for integrated career guidance and learning support. It fills a significant implementation gap identified in the literature, providing a functional proof-of-concept that combines recommendation systems, learning resources, and progress tracking into a single platform.

The project also highlights the growing importance of Artificial Intelligence in educational technology and career planning systems. By utilizing intelligent recommendation techniques and personalized learning support, the platform helps users better understand industry requirements and improve career readiness. “‘latex

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