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Research Paper

AI-BASED SKILL GAP ANALYZER & PERSONALIZED LEARNING ROADMAP

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ABSTRACT

The AI-Based Skill Gap Analyzer & Personalized Learning Roadmap is an intelligent system designed to analyze a user's existing skills and identify the knowledge or skill areas that need improvement for a selected career goal. In today's rapidly changing job market, organizations frequently introduce new technologies and job requirements, making continuous learning important for students, fresh graduates, and working professionals. However, many learners are unsure about which skills they currently possess and what they should learn next.

The proposed system uses Artificial Intelligence, Natural Language Processing, Machine Learning, semantic skill matching, and recommendation techniques to analyze user profiles and compare them with the requirements of selected job roles. Users can provide information such as education, technical skills, projects, certifications, experience, and career interests. The system can also analyze resume information to automatically extract relevant skills.

After creating the user's skill profile, the system compares it with a selected job role or career path. It identifies skills that are already available, partially matched, or missing based on the selected role requirements. The skill-gap analysis provides a structured understanding of the user's current position and the areas that require further development.

Based on the identified gaps, the system generates a personalized learning roadmap. The roadmap can recommend topics, courses, projects, certifications, practice activities, and learning sequences according to the user's career goal and existing knowledge. The system can also prioritize skills based on their relevance to the selected job role.

Overall, the proposed system helps users move from current skills → skill-gap identification → learning recommendations → practical development → career readiness. It can support students, job seekers, fresh graduates, and professionals in planning their learning journey. Future enhancements can include real-time job-market analysis, adaptive assessments, multilingual support, AI mentoring, progress prediction, project recommendations, and integration with verified learning and employment platforms.

I. INTRODUCTION

The modern employment environment is continuously changing due to advances in Artificial Intelligence, cloud computing, cybersecurity, data science, software development, automation, and other technologies. New job roles frequently introduce new technical and professional requirements. As a result, learners need to continuously develop their skills to remain aligned with their desired career paths.

Students and job seekers often know the technologies they have studied but may not clearly understand how their current skills compare with the requirements of a particular job role. A person interested in becoming a software developer, data analyst, cybersecurity engineer, or cloud engineer may need a different combination of skills. Manually comparing these requirements with personal capabilities can be difficult.

Traditional career-guidance platforms generally provide lists of courses, job postings, or predefined learning paths. These resources may not always consider the learner's current skill level, previous education, projects, or specific career objective. As a result, learners may spend time studying topics they already know while missing important skills required for their target role.

Artificial Intelligence can help address this problem by analyzing a user's profile and comparing it with structured job-skill requirements. NLP can extract skills from resumes and job descriptions, while semantic matching can identify related skills even when different terminology is used. Recommendation techniques can then identify suitable learning resources based on the detected gaps.

The main objective of the **AI-Based Skill Gap Analyzer & Personalized Learning Roadmap** is to provide personalized and structured career-learning guidance. Instead of presenting the same learning path to every user, the system analyzes individual requirements and generates a roadmap that starts from the learner's current skill level and progresses toward the selected career goal.

II. LITERATURE SURVEY

Traditional career-guidance systems provide information about occupations, qualifications, courses, and employment opportunities. Users generally search for a career role and manually determine which skills or qualifications are required. These systems provide useful information but may not perform detailed comparisons between an individual's current skills and target-role requirements.

Skill assessment systems have been developed to evaluate learner knowledge through quizzes, tests, coding exercises, and competency assessments. These systems can measure specific abilities and identify areas where a learner performs poorly. However, assessment-based systems may focus on individual subjects rather than providing a complete career-oriented skill-gap analysis.

Recommendation systems have been widely used in education and online learning platforms. Content-based and hybrid recommendation techniques can recommend courses based on user interests, previous learning activities, and content characteristics. Such systems demonstrate how personalized recommendations can improve the discovery of relevant learning resources.

Natural Language Processing has also been applied to resume and job-description analysis. NLP techniques can extract skills, qualifications, experience, tools, and responsibilities from unstructured text. Semantic similarity and embedding-based approaches can compare extracted skills between resumes and job descriptions even when exact keywords are different.

Machine Learning and Generative AI have expanded personalized learning capabilities. AI models can analyze learner profiles, identify knowledge gaps, generate explanations, and recommend learning activities. Generative AI can also create personalized study plans and project suggestions. However, recommendations should be grounded in reliable job-role information and learning resources rather than unsupported assumptions.

Recent intelligent career platforms increasingly combine skill extraction, job matching, competency analysis, recommendation systems, and Generative AI. These systems provide opportunities for continuous career guidance but still face challenges involving skill-taxonomy quality, changing job requirements, recommendation accuracy, explainability, and data freshness. The proposed system combines these approaches to provide an integrated **skill-gap analyzer and personalized learning roadmap**.

III. SYSTEM ANALYSIS

The **AI-Based Skill Gap Analyzer** is designed to analyze a user's current capabilities and compare them with the skills required for a selected career role. The system collects information such as education, technical skills, projects, certifications, experience, and career interests through a user profile or resume upload. An NLP module extracts relevant skills, technologies, qualifications, and experience from the provided information. A skill-normalization component maps different names or related terms to standardized skill categories. The system maintains a career-skill knowledge base containing job roles, required skills, proficiency levels, and related competencies. A skill-matching engine compares the user's profile with the selected career requirements. The analyzer classifies skills into matched, partially matched, and missing categories based on available evidence. A gap-prioritization module identifies which missing skills are more relevant to the target role. The recommendation engine searches for suitable learning topics, courses, projects, certifications, and practice activities. A Generative AI component organizes these recommendations into a personalized learning sequence. The roadmap can be divided into beginner, intermediate, and advanced stages depending on the user's current knowledge. Progress tracking allows users to update completed skills and learning activities. Finally, the system can regenerate or update the roadmap when the user's career goal, skills, or target job requirements change.

Existing System

Existing skill-development and career-guidance systems generally provide generic courses, job descriptions, skill lists, and career information. Users usually select a career role and manually inspect the required skills. Online learning platforms recommend courses based on browsing history, previous learning activity, or selected interests. Job portals can show required skills in job descriptions but generally leave the comparison with the user's current capabilities to the user. Resume analysis tools may

extract skills from resumes but may not provide a detailed learning roadmap. Some assessment platforms identify strengths and weaknesses through tests but may not connect these results with specific job requirements. Traditional career guidance can also depend heavily on manual advice from teachers, mentors, or career counselors. Learners may receive large numbers of course recommendations without knowing which ones should be completed first. Generic learning paths may not consider what the learner already knows. Job requirements can also change over time as technologies and industry practices evolve. These limitations create a need for an AI-based system that connects personal skills, career requirements, skill gaps, and learning recommendations.

Disadvantages of Existing System

- Provides generic learning paths.
- Limited personalization.
- Manual comparison of skills and job requirements.
- Difficult to identify missing skills.
- Large number of courses can create confusion.
- Limited connection between job roles and learning paths.
- Resume analysis may be separate from learning recommendations.
- Skill assessments may focus on limited areas.
- Learning sequence may not be personalized.
- Job requirements can change over time.
- Limited progress-based roadmap updates.
- Users may not know which skills should be prioritized.

Proposed System

The proposed **AI-Based Skill Gap Analyzer & Personalized Learning Roadmap** provides an integrated platform for analyzing current skills and creating a career-specific learning plan. Users can enter their skills and qualifications manually or upload a resume for automated skill extraction. The NLP module identifies technical skills, tools, programming languages, certifications, projects, and experience from the provided information. A skill-normalization layer maps extracted terms to standardized skill categories and related competencies. The system maintains a career-skill knowledge base containing job roles, required skills, proficiency levels, and competency relationships. The skill-matching engine compares the user's profile with the requirements of the selected target role. Skills are categorized into matched, partially matched, and missing areas based on the available profile evidence. The system prioritizes skill gaps according to their relevance to the selected career objective. A recommendation engine identifies suitable learning topics, courses, projects, certifications, and practical exercises for the identified gaps. Generative AI organizes these resources into a personalized roadmap based on prerequisites and current skill levels. Users can track completed learning activities and update their skill profile as they progress. The system can then recalculate remaining gaps and adjust the roadmap. This creates a continuous learning cycle that connects career goals with measurable skill development.

Advantages of Proposed System

- Provides personalized skill-gap analysis.
- Compares skills with specific career requirements.
- Supports resume-based skill extraction.
- Identifies matched and missing skills.
- Prioritizes important skill gaps.
- Generates personalized learning roadmaps.
- Recommends courses and learning topics.
- Suggests practical projects and exercises.
- Supports skill-progress tracking.
- Can update recommendations as skills improve.
- Connects career goals with learning activities.
- Reduces unnecessary or repetitive learning.

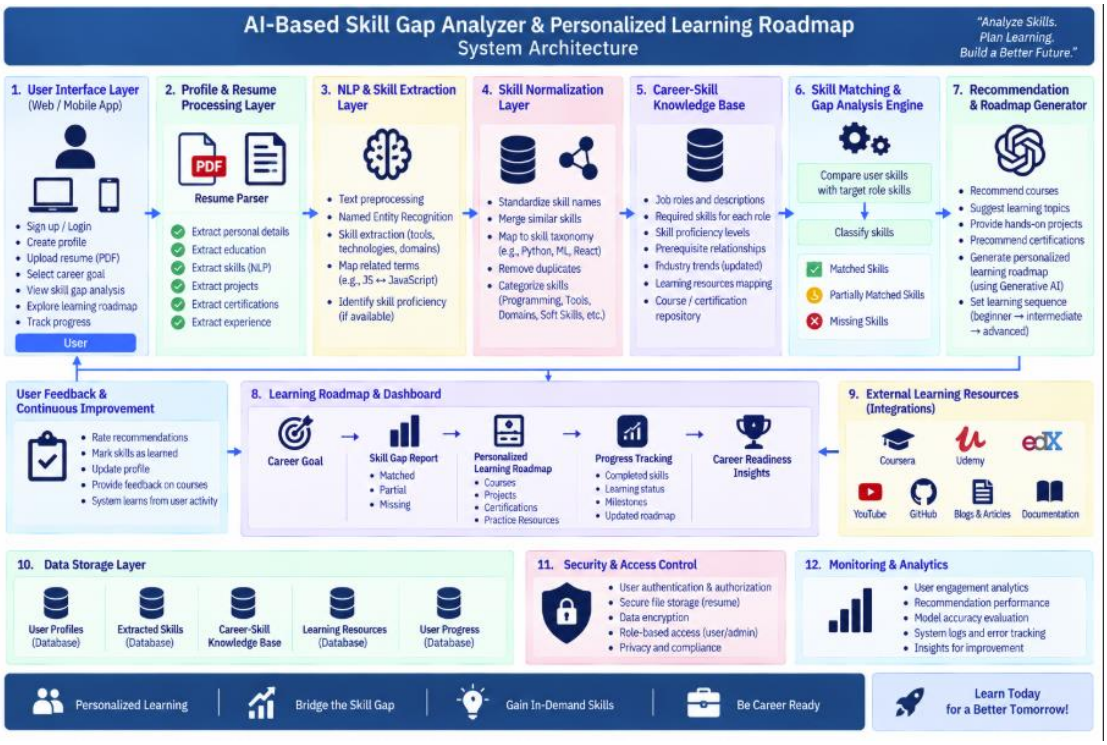
IV. METHODOLOGY

The methodology begins when the user creates a profile or uploads a resume containing education, skills, projects, certifications, and experience. The NLP module processes the input and extracts relevant skills, technologies, qualifications, and professional information. A skill-normalization component maps extracted terms to standardized skills and related concepts. The system retrieves the requirements of the user's selected target career or job role from a maintained career-skill knowledge base. The skill-matching engine compares the user's current skill profile with the required skills for that role. Each skill is evaluated according to available evidence and the required proficiency level. The system identifies matched, partially matched, and missing skills to create a detailed skill-gap profile. A prioritization module determines which gaps are most relevant to the user's selected career objective. The recommendation engine searches for appropriate learning topics, courses, projects, certifications, and practice activities. Generative AI organizes the recommendations into a structured roadmap based on prerequisites and the learner's current level. The roadmap can contain short-term, intermediate, and advanced learning stages with measurable activities. Users can record completed learning activities and update their skills as they progress. The system periodically recalculates the skill gaps and adjusts recommendations based on the updated profile and changing career requirements.

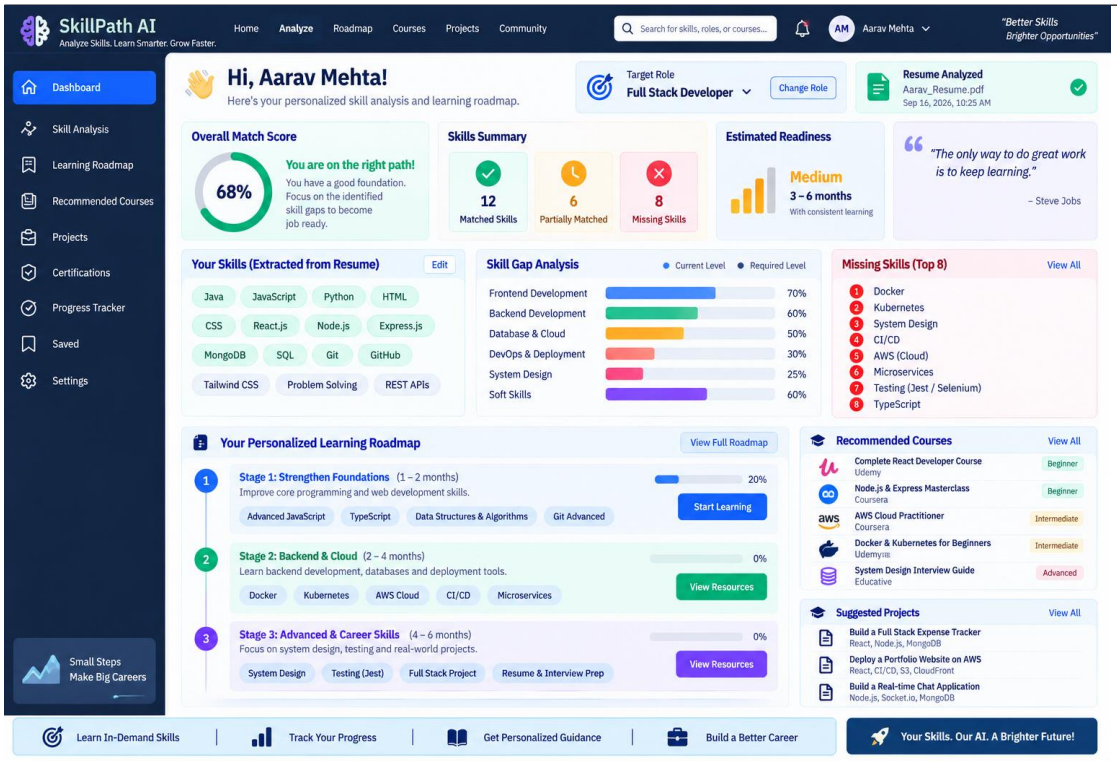
SYSTEM ARCHITECTURE

The AI-Based Skill Gap Analyzer & Personalized Learning Roadmap consists of multiple layers for user profiling, skill extraction, career-role analysis, skill matching, recommendation, and roadmap generation. The User Interface Layer allows users to create profiles, upload resumes, select career goals, view skill gaps, and track learning progress. The Profile and Resume Processing Layer collects education, skills, projects, certifications, and experience and extracts relevant information from uploaded documents. The NLP and Skill Extraction Layer identifies technical skills, tools, technologies, qualifications, and related competencies. The Skill Normalization Layer maps different skill names to standardized skill categories. The Career-Skill Knowledge Base stores job roles, required skills, proficiency levels, prerequisites, and competency relationships. The Skill Matching Engine compares the user's profile against the selected career requirements. The Skill Gap Analysis Engine identifies matched, partial, and missing skills and calculates their relevance to the target role. The Recommendation Engine retrieves appropriate learning resources, projects,

certifications, and practice activities. The Generative AI Roadmap Engine organizes these recommendations into a personalized sequence based on current skill level and prerequisites. The Progress Tracking Layer records completed activities and updates the learner profile. The Feedback and Analytics Layer evaluates learning progress and recommendation relevance. Finally, the system can continuously update the roadmap when the user's skills or career requirements change.



V. RESULT AND OUTPUT



VI. CONCLUSION

The AI-Based Skill Gap Analyzer & Personalized Learning Roadmap provides an intelligent approach to understanding the difference between a user's current skills and the skills required for a selected career or job role. The system helps users identify their strengths, missing skills, and areas that require further improvement.

The proposed system combines Artificial Intelligence, Natural Language Processing, skill extraction, semantic matching, recommendation techniques, and Generative AI to analyze user profiles and career requirements. By processing information from resumes, educational backgrounds, projects, certifications, and existing skills, the system can create a structured skill profile for each user.

A major feature of the system is its personalized learning roadmap. After identifying skill gaps, the system can recommend relevant topics, courses, certifications, practical projects, and exercises. These recommendations can be organized into different learning stages based on the user's existing knowledge and the requirements of the selected career goal.

The system also supports progress tracking and continuous skill-gap analysis. As users complete learning activities and acquire new skills, their profiles can be updated and the roadmap can be adjusted accordingly. This creates a continuous learning cycle that helps users gradually move toward their desired career objectives.

Overall, the AI-Based Skill Gap Analyzer & Personalized Learning Roadmap demonstrates how AI can support personalized career development and learning planning. It can be useful for students, fresh graduates, job seekers, professionals, educational institutions, and career-guidance platforms.

Future enhancements can include real-time job-market skill analysis, AI-based skill assessments, multilingual and voice interaction, adaptive learning paths, personalized project generation, interview preparation, verified course recommendations, industry-specific roadmaps, and integration with employment platforms. The system should present its recommendations as guidance, since actual job requirements and employer expectations may vary.

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