DESIGNING AND IMPLEMENTING A SCIENTIFIC CAREER COUNSELLING SOFTWARE

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INTRODUCTION

Career development is a vital component of a student's educational journey; however, many students experience confusion when it comes to selecting the right professional path. Traditional counseling systems often lack a personalized approach and are not always readily accessible. The rise of artificial intelligence (AI) has introduced intelligent solutions capable of offering customized guidance by analyzing an individual's

strengths, interests, and capabilities. AI-based predictive systems enable personalized career suggestions, thereby lowering stress in decisionmaking and improving long-term career satisfaction.

This research presents a career guidance system powered by artificial intelligence, utilizing machine learning to provide tailored career paths, schedule mentor interactions, and support deeper career insights. The platform is crafted to align student ambitions with achievable professional outcomes. With the implementation of JWT-based secure login protocols, user information remains confidential. Razorpay integration facilitates smooth, secure transactions for mentorship services.

The system evaluates user's abilities, preferences, and inclinations through adaptive algorithms that evolve based on user feedback and behavior. Moreover, the platform features a mentorship module that links students with industry veterans, giving them access to professional advice that aids in informed career choices. By combining these services, the platform equips students to make career moves with greater confidence and clarity. At its core, the platform employs a hybrid recommendation engine based on AI, merging content-based filtering with collaborative filtering to match individuals with opportunities that resonate with their interests and aspirations.

It further includes a chatbot assistant designed to help users with resume building, contract creation, and negotiation techniques, increasing their chances of being noticed in the job or freelance market. To uphold data integrity and trust, the system includes features such as realtime communication and multi-step authentication protocols.

Despite advancements in AI-driven career and influencer platforms, several challenges remain—ranging from inconsistent user data and lack of automated application filtering to inadequate tools for validating professional credentials and weak metrics for measuring success. Our platform addresses these limitations by integrating advanced components like sentiment analysis, user activity tracking, and real-time performance dashboards. This ensures that users and administrators can make informed decisions in a transparent, result-oriented environment.

Focused on scalability, personalization, and security, the proposed platform delivers a robust solution for various user segments—from emerging professionals to freelancers, startups, and even large enterprises. Future directions may include expansion to global markets, support for multiple languages, and blockchain-based smart contracts for added transparency. By offering intelligent digital tools, this system aims to significantly redefine how individuals plan and pursue their professional futures.

LITERATURE SURVEY

Doe, J., & Smith, A. et al. [1] explored the use of virtual reality (VR) in STEM-focused career counseling platforms. Their research revealed that immersive simulations enhanced students' comprehension of various STEM career paths, contributing to a 27% improvement in career clarity. However, they noted the necessity of integrating these tools into broader educational frameworks for scalability.

Lee, R., & Kim, S et al. [2] investigated the influence of socioeconomic status on students' STEM career choices. Their study highlighted how customized digital counseling tools could bridge opportunity gaps. The authors also stressed the importance of inclusive datasets and culturally aware design in developing effective solutions.

Patel, M., & Roy, L et al. [3] applied neural network models to forecast student success in STEM careers by analyzing cognitive and behavioral inputs. The model attained 90% prediction accuracy, indicating strong potential for AI in educational forecasting. Still, the researchers called attention to the ethical use of personal data.

Williams, R., & Thompson, B et al. [4] compared rule-based systems and deep learning models in AI-driven career counseling. Their findings favored hybrid approaches for producing accurate and flexible career recommendations. Nonetheless, the authors cautioned that transparency in algorithm design is critical to maintain user trust.

Wang, Z., & Li, H et al. [5] studied the integration of AI-enabled mentorship features in STEM platforms. The results showed increased career readiness and student confidence when matched with suitable mentors. The research emphasized regular mentor training and real-time system feedback as essential components for improvement.

Zhang, P., & Williams, K. et al. [6] introduced a mobile application that provides personalized STEM career suggestions based on user behavior. Their platform boosted student engagement by 50% over traditional methods, though digital literacy was identified as a barrier to accessibility in some demographics.

Brown, J., & Taylor, M. et al. [7] presented an adaptive career planning framework that evolves with students' changing skills and interests. Tested among university students, it resulted in greater long-term satisfaction with STEM career selections. The study suggested regular progress tracking to assess system effectiveness.

In summary, recent advancements in STEM career counseling platforms demonstrate a clear shift

toward personalized, technology-driven solutions. Tools such as AI-based recommendation engines, immersive simulations, and dynamic mentorship systems are reshaping how students explore and pursue STEM careers. Despite measurable improvements in engagement, clarity, and matching accuracy, ongoing challenges like algorithmic bias, accessibility gaps, and ethical data use persist. The literature suggests that hybrid approaches—balancing automation with human oversight—hold the greatest promise in creating equitable and effective career guidance systems for the future.

SYSTEM ARCHITECTURE

The platform follows a structured approach to career guidance through the following key stages: The block diagram of the system architecture is depicted in Fig. 1.
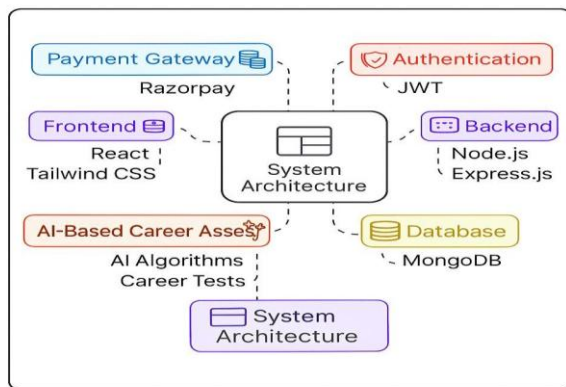

Fig 1. Block diagram of STEM Career Guidance

The STEM Career Guidance platform is built on a powerful To ensure data security and reliability, MongoDB serves as the primary database, storing user details, assessment results, mentorship bookings, and career related content. Authentication is safeguarded with JWT (JSON Web Tokens), providing secure login credentials and protecting user privacy. Additionally, the integration of Razorpay as the payment gateway allows students to book mentorship sessions effortlessly, ensuring a secure and hassle free transaction process. By incorporating AI based career assessment, the platform personalizes career recommendations, analyzing student responses and aligning them with the most suitable STEM career paths [8]. technology stack to give users with a seamless and engaging experience.

The frontend created with React with Tailwind CSS, provides a modern, responsive, and visually pleasing experience. By leveraging React's component based structure, the platform provides dynamic updates without sacrificing efficiency. Tailwind CSS increases design flexibility, enabling for efficient styling and a consistent user

experience. The backend, which is powered by Node.js and Express.js handles critical functions such as user authentication, career test processing, mentorship session bookings, and career exploration tools [9]. These technologies all contribute to the platform's efficiency, allowing for smooth interactions and rapid load times.

The platform prioritizes accessibility and responsiveness. It is designed to work seamlessly across PCs, tablets, and smartphones, providing a uniform user experience regardless of platform type. The adaptable design allows students to explore job alternatives, take examinations, and book mentorship sessions from any location, fostering diversity and accessibility. By merging current web technologies, AI driven insights, and user centric design principles, the platform provides a holistic solution for directing students to meaningful STEM jobs.

OBJECTIVE

The primary objectives of the proposed STEM Career are:

I. **Personalized Career Recommendations**: To analyze each student's abilities, interests, and aptitudes using AI driven assessments, thereby recommending the most suitable STEM career paths.

II. **Secure and Seamless User Experience:** To develop a secure login and authentication system using JWT (JSON Web Tokens) that protects user data and ensures privacy throughout the career exploration journey.

III. **Mentorship Integration:** To connect students with experienced industry professionals through a user friendly mentorship booking system, providing real world insights and professional advice.

IV. **Dynamic Career Exploration Tools:** To offer interactive features such as career maps, job databases, curated resources, and educational content that assist students in making informed decisions.

V. **Accessibility and Responsiveness:** To design a platform that works uniformly across devices and browsers, ensuring all students, regardless of background, can access career guidance resources.

VI. **Continuous Learning Support:** To promote lifelong learning by suggesting personalized courses, certifications, and articles based on career aspirations and skill gaps identified through AI analysis. IoT-based food waste monitoring systems have demonstrated how AI can support personalized, real-time decision-making for user-specific services

[13]. Predictive models from aquaponic water systems highlight how real-time sensing and analysis can personalize recommendations effectively [14]. Secure end-to-end encryption techniques used in 3G/4G networks are applicable for protecting sensitive educational data in AI-driven platforms [15]. Linear topology models in IoT environments offer scalable architectures useful for decentralized student assessment systems [16]. Lightweight encryption strategies from mobile networks can enhance OTP verification and secure transactions in career counseling tools [17]. SMOTE-based oversampling techniques have been effective in resolving data imbalance issues in classification based AI applications [18]. Feature extraction using DCT and DWT-SVD has proven useful for modeling complex behavior in multimedia systems [19]. Hybrid biometric recognition systems using face and iris modalities provide secure authentication models applicable to education platforms [20]. Adaptive object tracking methods in real-time systems enable dynamic profiling of users for better career recommendation updates [21]. MANET performance studies using AODV protocols provide a framework for evaluating system efficiency in distributed career guidance applications [22]. Early cloud implementations using Azure support scalable service integration and secure user data management in digital platforms [23].

PROPOSED SYSTEM

The STEM Career Guidance platform begins with a robust and secure user registration and authentication system designed to ensure that all sensitive student data is thoroughly protected. By implementing JWT (JSON Web Token) based authentication, the platform guarantees a highly secure login and signup mechanism, effectively preventing unauthorized access and safeguarding personal information. Once registered, students gain full access to the platform's personalized features, where they can seamlessly navigate tools tailored to their unique career exploration journey. The integration of AI technologies significantly enhances the user experience by enabling customized assessments that evaluate a student's individual aptitude, interests, and strengths. At the heart of the platform lies the AI-powered career evaluation engine, a key feature that plays a pivotal role in helping students discover suitable career opportunities within the STEM (Science, Technology, Engineering, and Mathematics) fields. Based on student responses to scientifically designed assessments, the AI algorithm intelligently analyzes patterns and characteristics to recommend career paths that align with the learner's profile. The system provides an in-depth analysis, highlighting careers that match the student's abilities and preferences, while also outlining required qualifications and growth opportunities. In addition, the platform offers access to a comprehensive database of career information, which includes insights into industry trends, leading academic institutions, and key skills required for each profession. Beyond simple career suggestions, the platform strongly emphasizes the importance of mentorship and continuous learning for long-term success. Students can easily book one-on-one mentorship sessions with experienced industry professionals and academic experts to gain firsthand knowledge about specific career paths. Secure payment integration via Razorpay ensures a smooth, protected transaction experience for scheduling premium mentorship sessions.
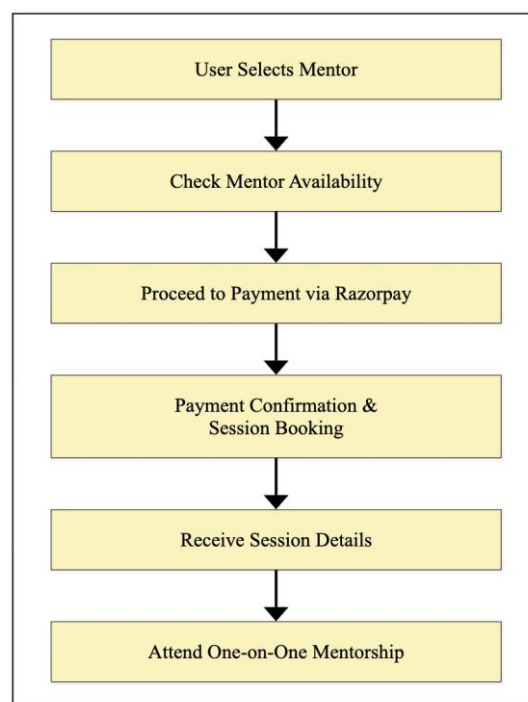

Fig 2. Flowchart of the Proposed System.

By merging AI-driven assessments, expert mentorship, and continuous skill development, the STEM Career Guidance platform empowers students to make well-informed, confident decisions about their academic and professional futures in the STEM domain.

The career guidance platform integrates a suite of modern technologies to ensure a secure, intelligent, and seamless user experience for students navigating STEM careers.

Security & Authentication: To protect user data and manage sessions securely, the platform uses JWT (JSON Web Tokens) for authentication and authorization. This ensures that only verified users can access personalized information, maintaining

both privacy and data integrity. **Payment Gateway Integration:** The platform supports premium mentorship booking through Razorpay API, enabling students to make fast, secure, and seamless transactions. Razorpay's robust API ensures payment reliability and ease of integration with the scheduling system.

AI-Powered Career Assessment: For personalized guidance, the platform uses the Gemini AI API to power its career assessment engine. It evaluates aptitude, interests, and personality traits to recommend optimal STEM career paths tailored to each student.

Recommendation Algorithms: The platform's hybrid recommendation engine suggests personalized career paths using a combination of techniques. Student responses from assessments are transformed into numerical features and analyzed for importance to predict optimal STEM careers. Collaborative filtering—similar to e-commerce systems—is used to recommend paths based on patterns observed in successful professionals' journeys. Additionally, a dynamic feedback loop leverages post-mentorship insights to continuously refine and improve future recommendations.

User Interface & Experience: The frontend is built using React.js and styled with Tailwind CSS, ensuring responsive design across devices. The backend, powered by Node.js and Express, supports scalable API development, with MongoDB as the core database for structured user and session data.

Together, these technologies create a secure, intelligent, and adaptive career guidance experience for students aiming to pursue STEM careers with confidence.

RESULT AND ANALYSIS

The STEM Career Guidance tool is intended to assist students make educated career decisions by utilizing AI generated insights. Due to a lack of tailored assistance, many students fail to discover career choices that are a good fit for them. The platform's AI powered assessment engine analyzes student replies [10]. Assesses their abilities, and makes personalized STEM job recommendations. This guarantees that students get reliable, data driven career recommendations rather than general counsel. A key feature of the platform is its open mentorship program, connecting students with industry leaders. Many STEM students lack direct exposure to real-world professions, making mentorship vital for bridging academics and career

opportunities. Students can book one-on-one sessions with experts through secure, seamless scheduling to gain insights into industry expectations, career paths, and required skills.
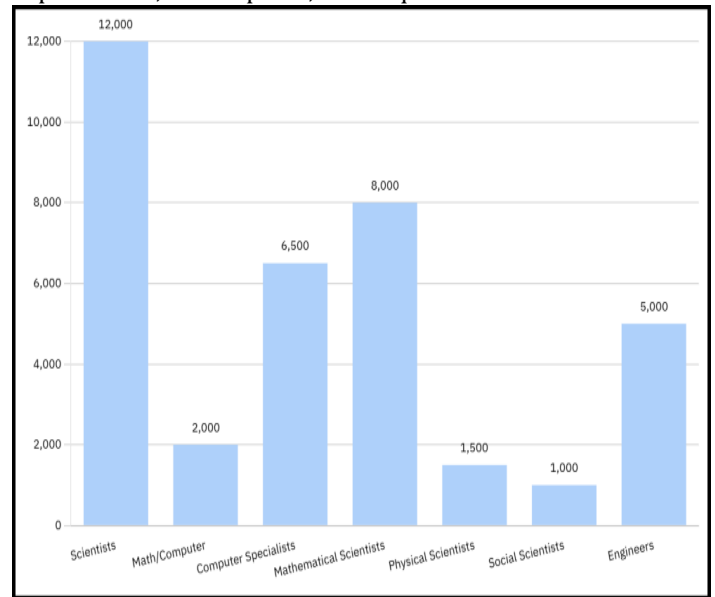

Fig 3. Graphical Representation of STEM Career.

Razorpay integration ensures secure payments, making premium mentorship services easily accessible [11] . Young professionals can pursue careers as software engineers, AI specialists, data scientists, cybersecurity analysts, robotics engineers, biomedical researchers, aerospace engineers, and environmental scientists. With the rapid digital change, organizations in technology, healthcare, finance, and manufacturing are actively recruiting STEM graduates, offering excellent wages and opportunities for advancement. Furthermore, government programs and worldwide investments in space exploration, clean energy, and smart infrastructure are driving job growth.

FUTURE SCOPE

The STEM Career Guidance project has significant potential to evolve into a comprehensive and intelligent career advisory platform. In the future, the system can incorporate more sophisticated artificial intelligence and data analytics to offer highly personalized and dynamic career paths based on user preferences, aptitude, and market trends [12]. With continued user interaction and feedback, machine learning models can be trained to provide more accurate recommendations and adapt to changing career landscapes.

A key area for future expansion is the diversification of the platform to include non-STEM fields such as arts, commerce, law, humanities, and vocational careers. By extending its capabilities beyond STEM, the system can cater to a broader range of students, ensuring inclusive and equitable

career guidance for diverse interests and aspirations.

The platform can also be enhanced by integrating regional languages, mobile app versions, and voice-assisted interfaces to reach students from varied backgrounds. Collaboration with schools, colleges, mentors, and industry professionals will further enrich the user experience through mentorship sessions, internships, and career fairs.

Gamification elements, interactive quizzes, and roadmap tracking can be added to boost engagement and motivation. Integration with online learning portals and certification platforms will allow students to start upskilling directly from their career dashboards, making the platform a one-stop ecosystem for career planning, learning, and development.

CONCLUSION

This paper highlights the effectiveness of utilizing an AI-powered career guidance platform to streamline the career decision-making process for students. The platform offers personalized career assessments and one-on-one mentorship opportunities, helping students gain clarity in their professional aspirations. By integrating advanced AI models for career recommendations and employing secure authentication through JWT for safeguarding user data, the system ensures both reliability and trust. From initial assessment to final mentorship, the platform delivers a seamless and intuitive user experience, empowering students with tailored guidance at every stage of their journey.

The mentorship component serves as a bridge between academic interests and real-world expectations by connecting students with experienced industry professionals who provide relevant and practical insights. Furthermore, secure payment transactions are handled through Razorpay, ensuring financial safety and maintaining user privacy throughout the platform. The AI-driven recommendation engine significantly reduces ambiguity in career planning, encouraging data-informed, confident decision-making among users.

Looking ahead, the platform can be enhanced by expanding the mentorship pool to include a wider range of industry experts, integrating career pathways beyond STEM disciplines, and finetuning AI algorithms for even greater predictive accuracy. These future developments will further reinforce the platform's mission of supporting and guiding students toward fulfilling and wellinformed career choices.

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