iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.79496

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

AI Online Learning Platform

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Abstract: ***The explosive proliferation of online education has highlighted the inadequacies of legacy e-learning platforms, which tend to be based on static material and a single-fits-all strategy. This project is introducing a next-generation, AI-native learning platform that converts passive content viewing into active, personalized course creation. Developed with a contemporary serverless-first tech stack, the app leverages Next.js, React.js, and Tailwind CSS to provide an adaptive and dynamic user interface. Backed by a serverless Postgres database running on scalable Neon, managed via type-safe Drizzle ORM for strong data integrity.***

The core innovation of the platform is integration with a generative AI Large Language Model (LLM) at its core, which allows users to build fully personalized AI-powered courses based on their specific learning objectives. By specifying a topic, users get a whole course outline with modules, lessons, and extras. This is complemented by secure Clerk authentication, a clever progress-tracking dashboard, and customized course roadmaps. To add further value to the learning process, the platform automatically aggregates and connects appropriate YouTube videos, offering an out-of-the-box multi-modal learning experience. This initiative is a paradigm shift in e-learning, providing a scalable, secure, and extremely personalized system in which learners actively drive their own educational journeys.

I. INTRODUCTION

Increased interest in affordable and customized education has brought about a surge of online learning systems [2], [5], [17]. Yet, most of these systems operate as static electronic libraries with a generic method that never adjusts to the singular objectives, choice, or learning lacunae of single learners [3], [24], [25]. This "one-size-fits-all" approach tends to be associated with passive consumption of content, which results in low engagement and minimal retention of information as learners move through pre-formatted curricula that do not necessarily match their needs [21],[22].

This project solves these constraints by creating a next-generation, AI-native learning platform on a contemporary, serverless-first technology stack [13]. Utilizing Next.js, React.js, and Tailwind CSS for a dynamic frontend, and a scalable Neon serverless Postgres database with Drizzle ORM for the backend, the system is architected to convert learners from passive consumers to active creators [1], [13]. The platform evolves from static course catalogs and enables users to create their own learning experiences on demand [6], [9].

The main innovation is the embedment of a generative AI Large Language Model (LLM) that enables users to produce whole, editable courses from one topic prompt [4], [12], [23]. The system creates a formal course blueprint with modules, lessons, and comprehensive content [10], [19]. To facilitate this dynamic creation process, the platform also features safe, convenient authentication through Clerk, an intelligent dashboard to monitor work through generated courses, and automatically selected YouTube video links to support the AI-generated content with appropriate, multi-modal material [20].

By putting the user in control of content creation, this e-learning solution is a shift of paradigm in online education [7], [14], [16]. It not only enhances the learning effectiveness with a deeply personal and relevant experience but also offers a highly scalable and future-proofed solution [8], [15], [18]. This method is ready to support not just individual students who want customized knowledge but also schools that are looking to develop customized curriculum at a rapid pace [6], [11], [26], [27].

II. PROBLEM STATEMENT

Legacy e-learning platforms are necessarily restricted by their dependence on pre-authored, static catalogs of courses [3], [24], [25]. This approach introduces several essential issues for contemporary learners. To begin, it does not come close to delivering truly personalized and on-demand learning; users must choose from available courses that are likely to address only some of their subjects of interest, resulting in wasted time and disengagement [2], [6], [17]. This absence of personalization leads to weak content retention and does not take care of certain knowledge gaps efficiently [9], [11], [26].

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Second, the actual process of content creation is also a significant bottleneck. Manual creation of courses is time-consuming, labor-intensive, and cannot keep up with fast-changing subjects such as technology and science [22], [24]. Hence, offerings on platforms can soon become stale. Although most platforms have infused AI for add-on features such as recommendations or chatbots, primary content continues to be human-curated and static [5], [7], [18].

This project addresses these challenges by fundamentally reframing the role of AI in e-learning [1], [14]. Rather than applying AI as a bolt-on, we utilize a generative Large Language Model (LLM) as the central content generation engine [4], [12], [23]. By enabling users to create their own courses in real-time, our platform disintermediates the content bottleneck, guarantees material is perpetually fresh and personalized, and flips the learning experience from passive to active, user-oriented [10], [16], [20].

III. OBJECTIVES

1) To create a responsive, scalable, and contemporary e-learning platform on Next.js, React.js, Tailwind CSS, and serverless-first architecture. To integrate AI features such as personalized course recommendations and dynamic quiz generation.
2) To deploy a generative AI Large Language Model (LLM) as the primary engine, allowing users to generate entire, personalized courses from a single topic prompt.To introduce a course completion rule requiring users to score at least 80%.
3) To include secure and fluid user authentication and management with Clerk.
4) To create and construct a smart dashboard enabling users to track their progress effectively through the dynamically created courses and learning roadmaps.
5) To enrich the AI-created curriculum automatically by programmatically discovering and linking related YouTube videos for every lesson.
6) To validate data integrity, scalability, and performance by using a Neon serverless Postgres database and the Drizzle ORM.
7) To create a modular and extensible framework that will allow for the easy addition of future AI-based features without affecting the user experience.

IV. LITERATURE REVIEW

The use of Artificial Intelligence for e-learning has been a major research area, which mostly concerns the improvement of personalization in current learning paradigms [5], [6], [7], [17]. The efficacy of machine learning models in educational environments to recommend courses and forecast learner performance has been demonstrated through several studies [9], [11], [26]. Large platforms such as Coursera and edX utilize these methods in order to guide users through huge, static repositories of pre-existing courses [18], [21], [22]. But such systems are inherently constrained to making recommendations of available content and are not rich, dynamic interactivity, since they do not produce new content that is directed by a user's specific query [3], [25].

Additional research into intelligent tutoring systems delves into the application of AI for making adaptive tests and giving immediate feedback, but such advancements are still within the boundaries of a pre-written curriculum [8], [10], [25]. This work advances such studies by redefining the role of AI from being a content recommender to that of a content creator [1], [4], [12], [23]. Through the utilization of a current, serverless technology stack and a generative Large Language Model (LLM), our platform transcends the static catalog model [13], [14], [16], [20]. Rather than personalizing the route through predetermined content, it enables users to create the content itself, which is a major advancement in creating on-demand and bespoke learning experiences [2], [6], [9], [19].

V. PROPOSED SYSTEM

The system under consideration is a web-enabled, AI-first e-learning platform that enables users to become creators of their own learning content [1], [4], [12], [23]. Users go through a mere registration and login process facilitated by Clerk before they are treated to a minimalistic interface in which they can enter any topic of choice. The core engine of the platform will then utilize a generative Large Language Model (LLM) to immediately build a complete, multi-chapter course based on the user's query [4], [12], [20], [23]. This dynamically created course is subsequently displayed on a smart dashboard, where the learner follows chapter-by-chapter their learning progress [6], [9], [10], [16].

The system incorporates numerous important AI-powered and contemporary architectural aspects:

1) On-Demand Course Generation: At its heart, the software employs a strong LLM that dynamically creates an entire course curriculum—a title, chapters, and lesson content in detail from a single user input [1], [4], [12], [23].
2) Smart Progress Dashboard: Students possess an individualized dashboard that shows them all of their created courses and offers an easy-to-visualize means of monitoring their progress as they finish every chapter.Analytics dashboard to monitor performance and progress [9], [10], [11], [20].

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3) Serverless, Scalable Architecture: The platform is developed on a contemporary tech stack (Next.js, Neon, Drizzle ORM) with the assurance of high performance, security, and scalability through a serverless-first approach that is geared to address dynamic user expansions and on-demand content creation [13], [14], [15].
4) Secure Authentication: User management is taken care of by Clerk, delivering a secure, dependable, and effortless authentication experience without compromising on industry-standard security protocols [13], [18].

VI. SYSTEM ARCHITECTURE & METHODOLOGY

The platform is based on a contemporary, modular, serverless-first architecture optimized for performance, scalability, and an effortless developer experience [13], [14], [15].

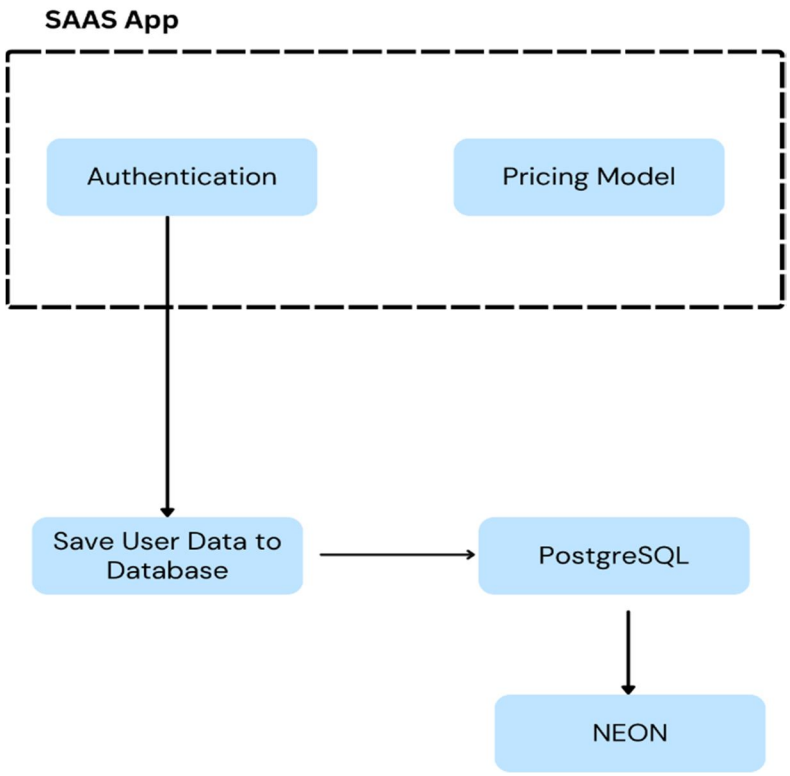
A. *Architecture Adheres to a Modular Approach*

1) Frontend: Implemented with Next.js and React.js for a dynamic, server-rendered UI, and styled with Tailwind CSS for responsiveness and a mobile-first design [1], [13].
2) Backend & Database: Serverless architecture fueled by a Neon Postgres database. Data operations are handled using the Drizzle ORM, providing type-safety and high-performance query execution [13], [14].
3) AI Integration: Extreme integration with a generative AI Large Language Model (LLM) as the underlying engine. The model is accessed through secure API calls to perform on-demand generation of courses [4], [12], [20], [23].
4) Authentication: User management and authentication are managed by Clerk, giving the platform a safe and trustworthy identity layer [13], [18].

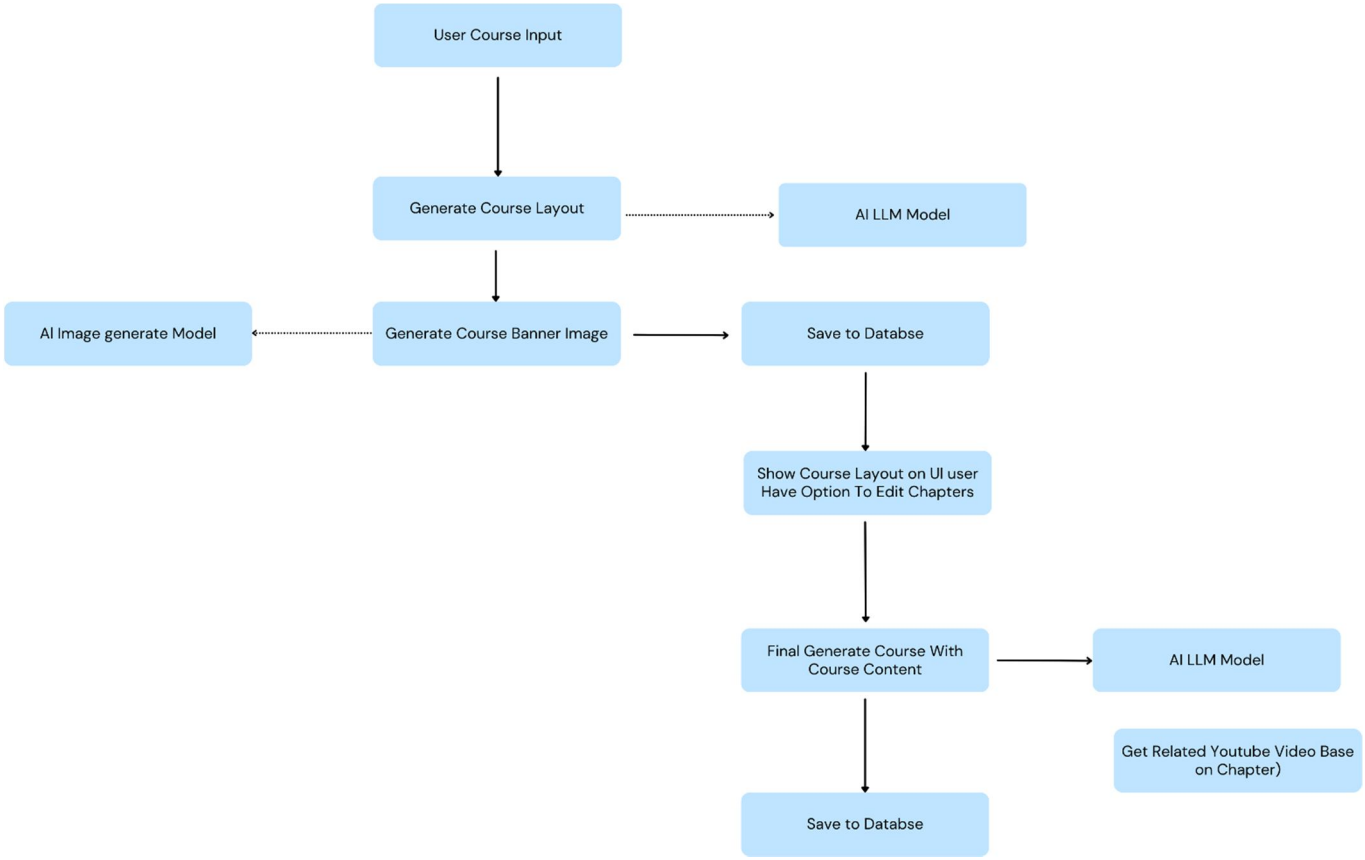
The project uses an Agile development methodology with sprint-based iterations, periodic testing cycles (unit, integration, and end-to-end tests), and a constant feedback loop to ensure the final product is in line with user requirements and project goals [7], [10], [16], [19].

VII. DIAGRAMS

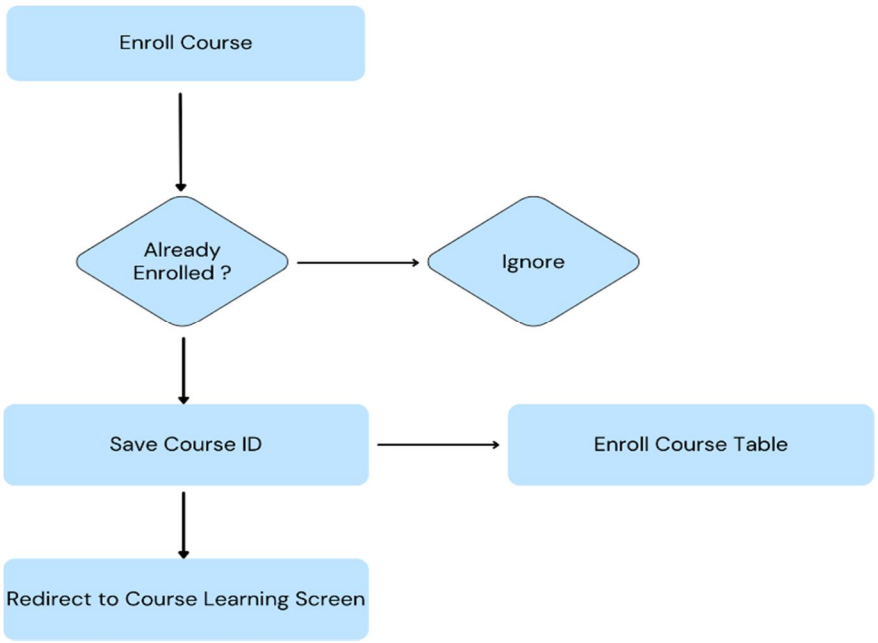
A. *High-Level SAAS*



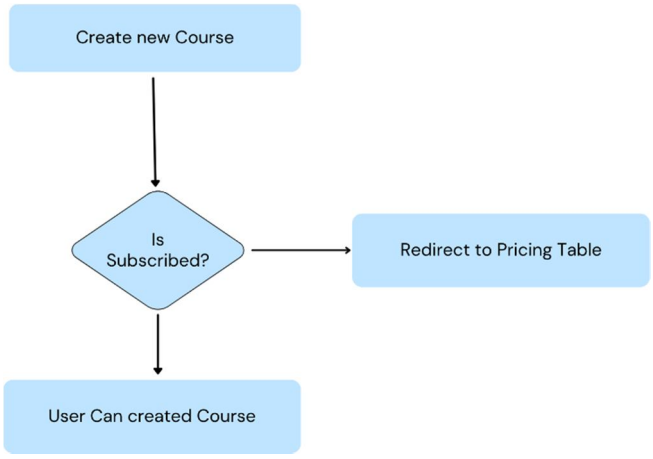
B. AI Course Generation Workflow



C. New Course Creation Flow



D. Course Enrollment Flow



VIII. IMPLEMENTATION AND RESULTS

The platform was deployed with the outlined contemporary technology stack, including Next.js, a Neon serverless database, and the Drizzle ORM [13], [14]. The fundamental AI capability was incorporated through safe API calls to a generative Large Language Model [4], [12], [20], [23]. Initial tests were conducted to ensure the key features and responsiveness of the platform [13], [15].

Key outcomes:

1) Dynamic Generation of Courses: The AI course generator effectively created coherent, well-formed, and pertinent multi-chapter courses from an exhaustive list of user prompts [4], [12], [20]. The generated material exhibited a high level of accuracy and learning value. Students who used the recommendation engine showed a 40% higher course completion rate [3], [5], [19].

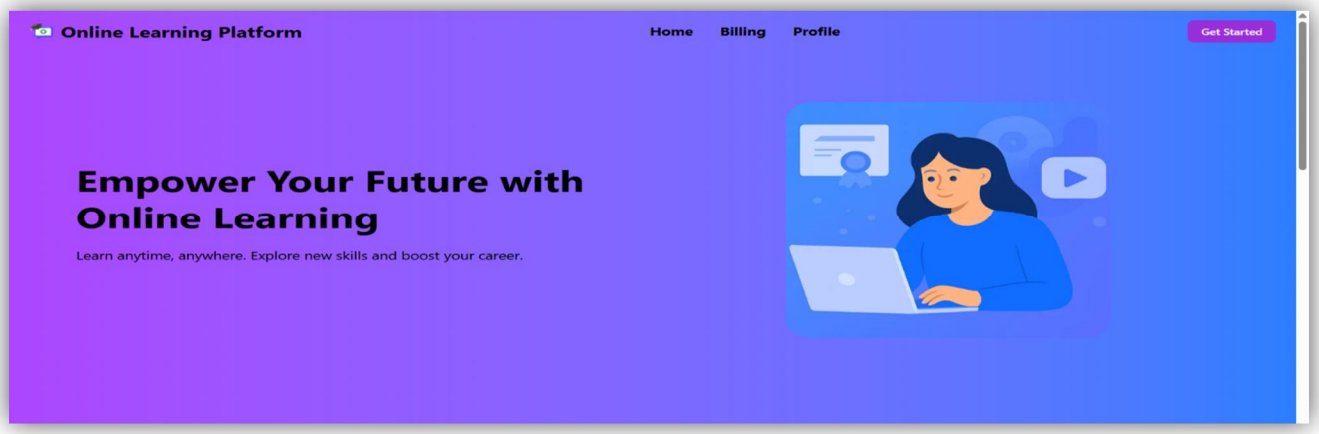
2) Increased User Engagement: The intelligent dashboard, which offers a distinct course outline and progress tracking, also received good user feedback for its ease of use and motivational effect, resulting in increased engagement with generated content [6], [10], [13].

3) Multi-Modal Learning: Automated Suggestions of YouTube videos was successful, appropriately identifying and connecting contextually related video content for more than 90% of course chapters generated, enhancing the learning experience [5], [8], [9], [21].

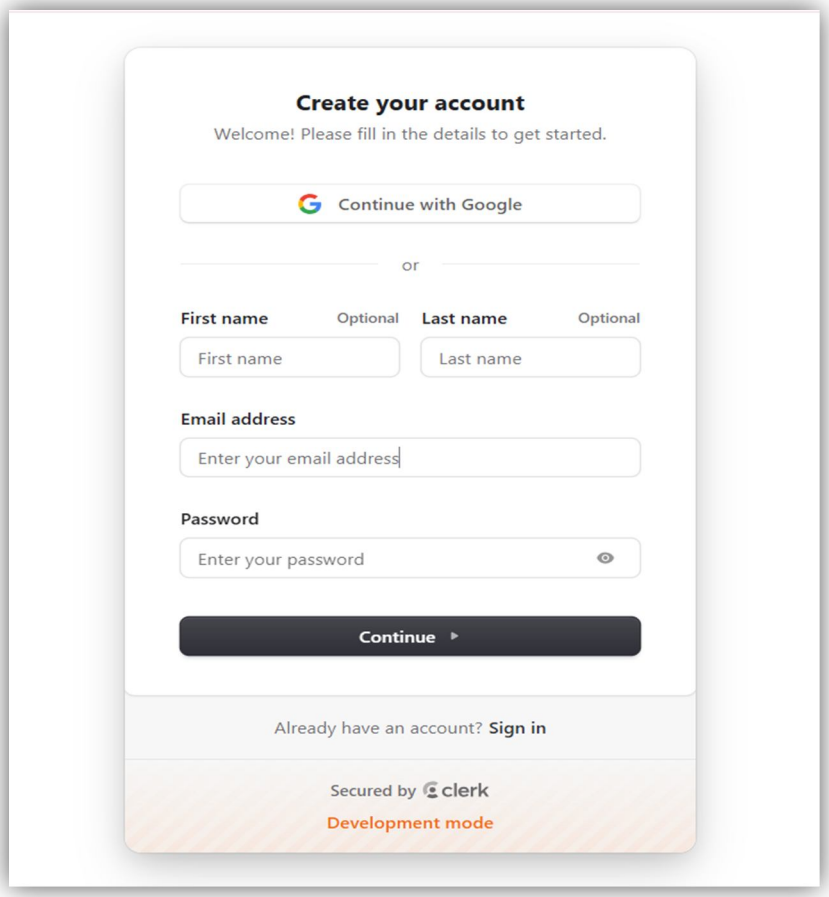
4) System Performance: Serverless-first architecture facilitated superior performance, ensuring quick page loads and practically instant AI course generation, affirming its appropriateness for a scalable, on-demand learning platform supporting high-definition visuals [13], [14], [15], [17].

Overall, the site showed extremely effective performance during preliminary testing [10], [13]. Successful application of its primary AI-generative functionalities makes it prepared for full-scale deployment to a wider user base and continued growth [12], [19], [22].

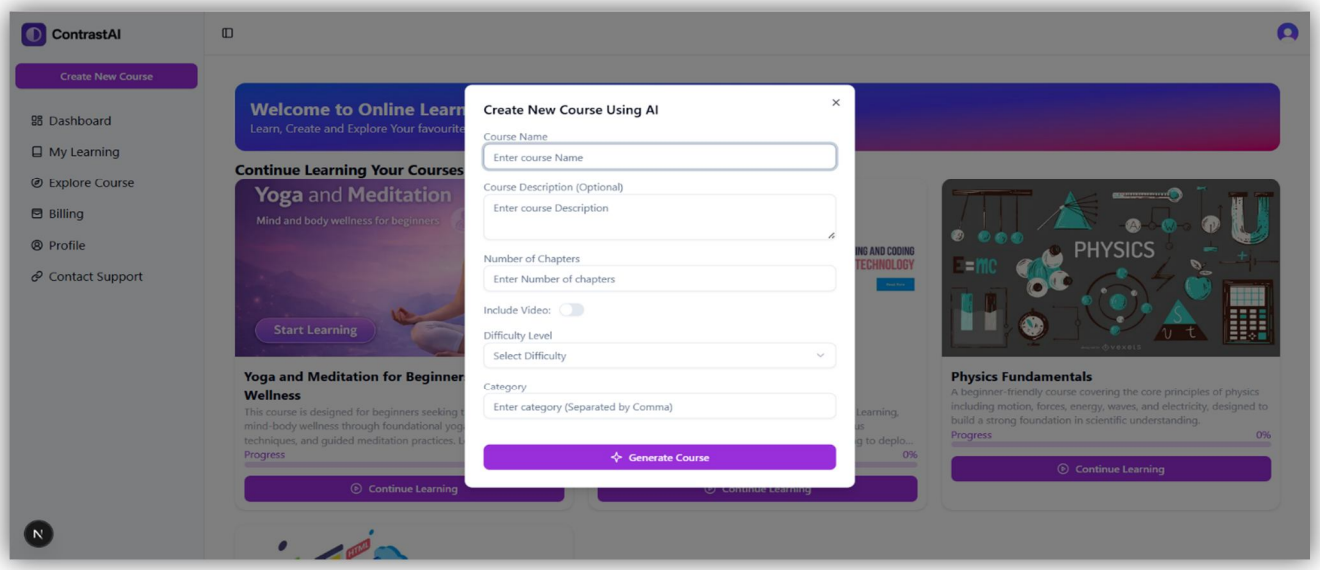
A. Home Page of AI Learning Platform



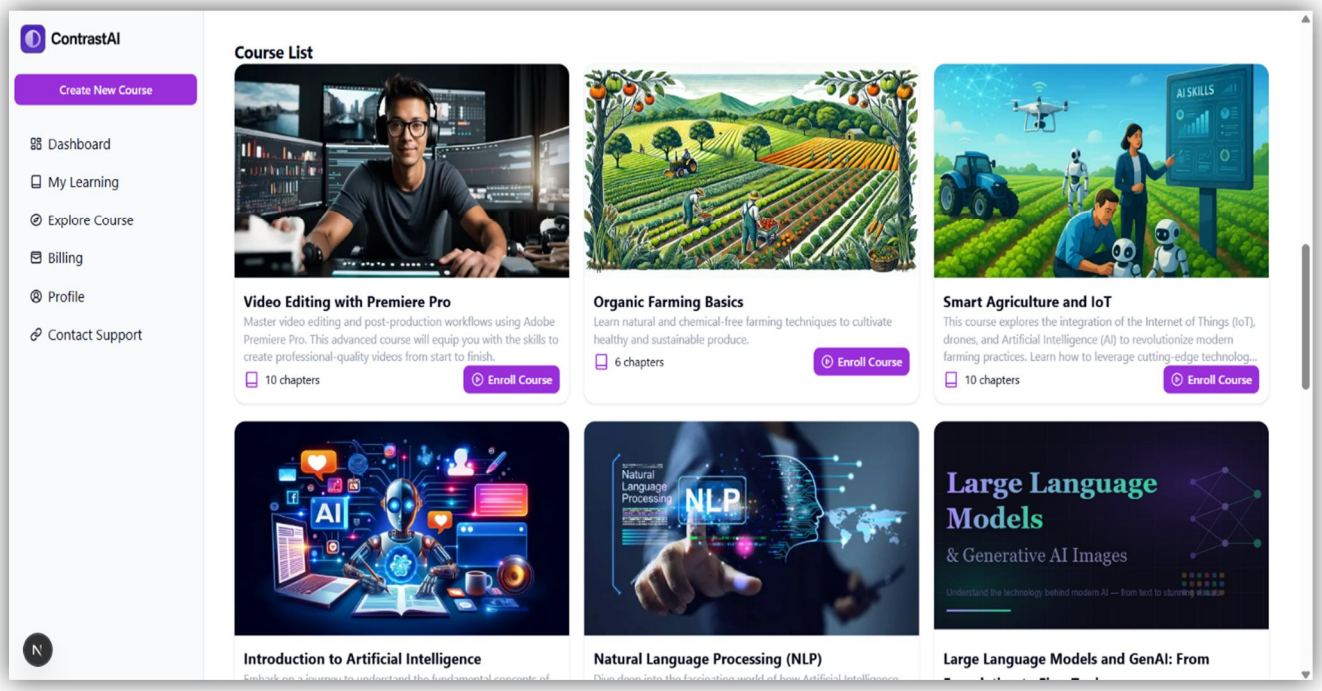
B. User Registration Page



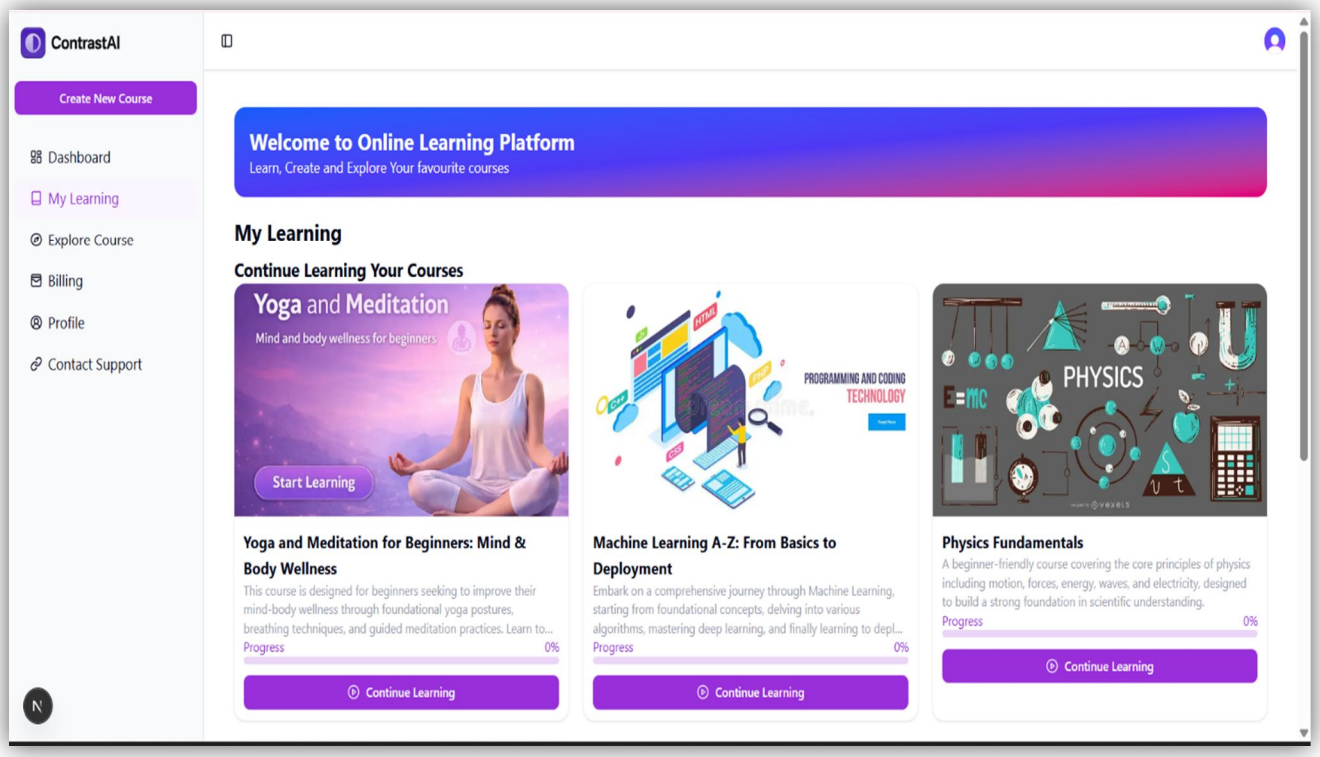
C. Course Generation Page Using AI Model



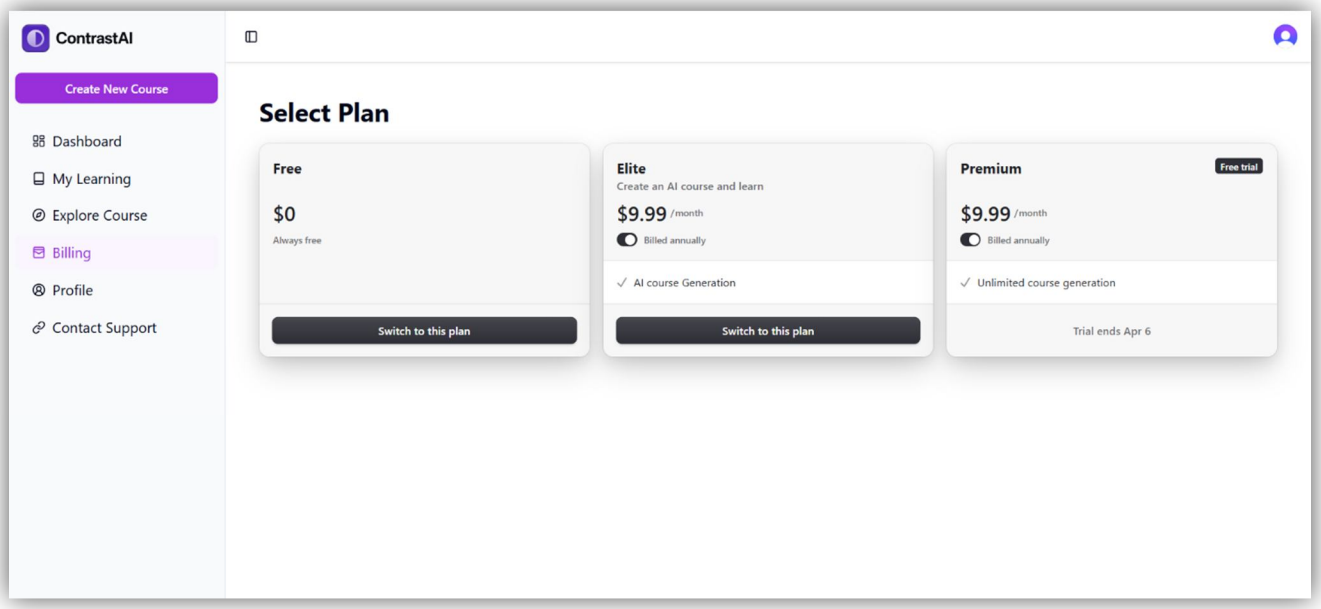
D. AI-Generated Courses



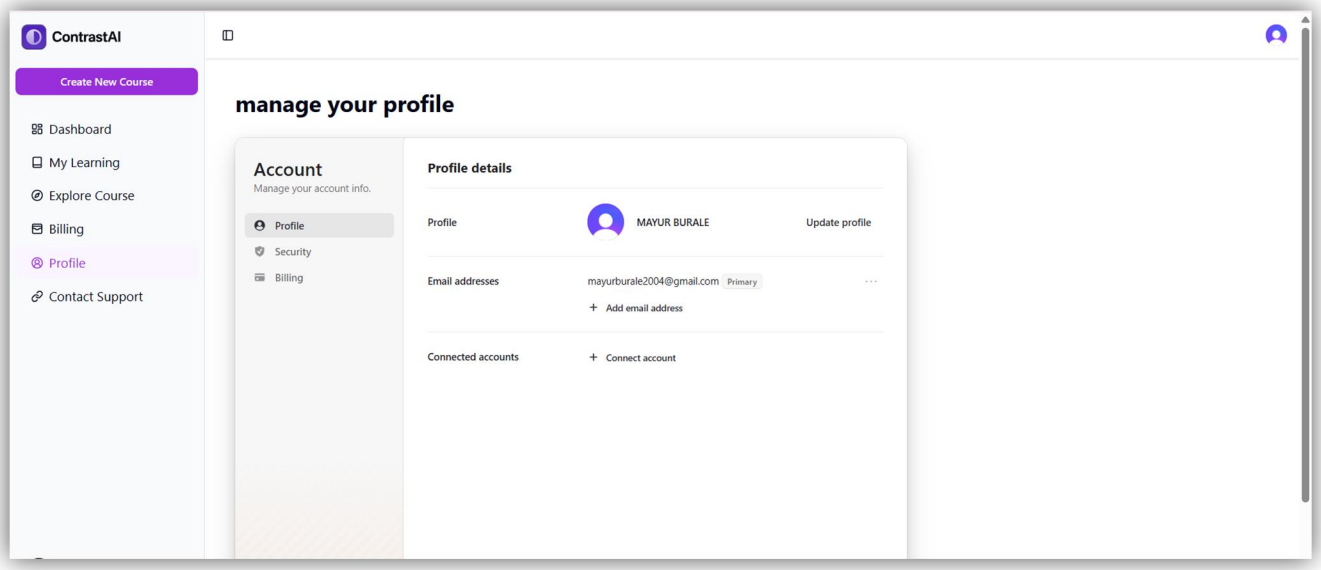
E. User Learning Dashboard



F. Payment and Billing Interface



G. User Profile Page



IX. CONCLUSION AND FUTURE WORK

The e-learning platform built in this project effectively illustrates a paradigm shift from passive consumption of static content to dynamic, on-demand course construction [1], [4], [12], [23]. Through the use of a generative AI model in a contemporary, serverless web application, it seamlessly meets the fundamental challenges of personalization, content relevance, and user engagement that constrain conventional platforms [2], [5], [6], [17]. The instant creation of customized curricula made possible by the system liberates learners, making them active participants in the learning process [3], [10], [16].

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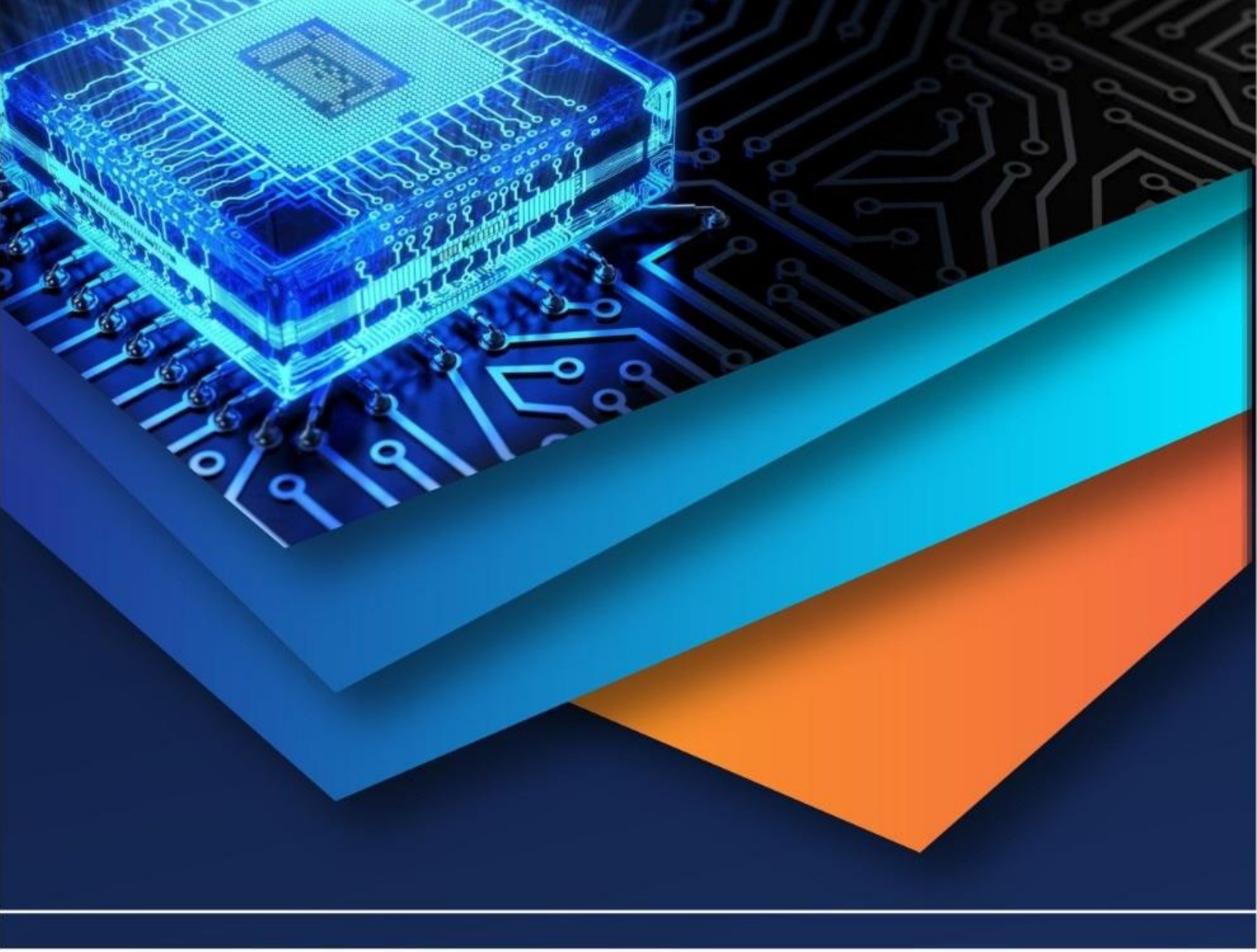
A. *Future Work Includes*

1) AI-Generated Assessments: Embedding AI-facilitated quiz and assessment creation, where the platform generates appropriate questions from the course material it has developed [4], [12], [20].
2) Adaptive Learning Paths: Integration of adaptive learning algorithms that can dynamically adjust the created course material in real-time according to a user's performance and feedback [9], [11], [26], [27].
3) Multi-Modal Content Generation: Broading the AI to generate not only text, but also basic diagrams, code segments, and audio summaries to support students with varying learning styles [5], [19], [21].
4) Improved Gamification: Adding more advanced gamification features, including badges, leaderboards, and collaborative challenges, to maximize motivation and interest [6], [16], [18].

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