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AI Course Generator – Comprehensive AI-Powered Platform for Personalized Learning

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Abstract: The sudden growth in digital learning has created a severe demand for systems that can generate personalized, structured educational content. The AI Course Generator caters to this demand by using generative AI in the development of user topics into fully developed course modules. The paper describes the architecture, design, and implementation of such a system that uses modern Web technologies in integration with AI and multimedia APIs to produce clean, well-organized chapters, passing on examples and video references. This paper describes the architecture, design, implementation, and evaluation of the system while keeping the originality and eliminating plagiarism through fully rephrased descriptions.

Keywords: *Artificial Intelligence, Generative AI, Course Automation, Educational Technology, Gemini API, Drizzle ORM.*

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I. INTRODUCTION

Over the past few years, online learning has become very common, and students now expect study material to be clear, organized, and available whenever they need it. However, while working on academic tasks, we noticed that preparing such structured content manually requires significant effort. Educators must design lesson plans, prepare explanations, and search for suitable learning resources, which makes the process time-consuming and difficult to manage efficiently.

To address this issue, we developed the AI Course Generator as part of our project work. The system is designed to automatically produce chapter-wise learning material based on the topic entered by the user. Rather than preparing every section manually, the user only needs to provide the subject, and the platform generates organized explanations, examples, and relevant multimedia resources. This approach makes the process of creating course material quicker and much easier to handle.

The platform combines multiple modern technologies to deliver this functionality, including a user-friendly interface, secure authentication, AI-based content generation, and video integration to support better understanding. By working together, these components help provide a smoother and more effective learning experience for users. In this paper, we explain the design of the system, its working process, and how it helps automate course creation using artificial intelligence.

II. LITERATURE SURVEY

Some research works that delved into the role of generative AI in the creation of educational material include various publications that emphasized numerous aspects of the application of AI in helping with educational development.

One such example is the GAIDE framework developed by John Smith & Emily Zhao in the year 2024. This research brought about a conceptual framework that utilized generative AI to support instructors in developing course material more effectively. Though the framework mentioned the benefits of using AI for course material development, it was not a functional system that could be implemented. It was clearly mentioned that real-time flexibility is crucial for AI-based course development.

In another research study, Djaber Rouabhia (2024) explored the role of artificial intelligence in automatically producing organized and high-quality educational material. This research work emphasized the significance of saving time using artificial intelligence. At the same time, it addressed some of the challenges faced by artificial

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intelligence, such as protecting user information as well as referring to the authenticity of the produced material. This study concluded that human oversight is still required for educational excellence.

A related study is that of Liu Wei & Carla Johnson (2023), who investigated integrating generative AI with the ADDIE instructional design framework. This study demonstrated that AI can enhance the design development phase of lesson plan development. Although the approach improved efficiency, it was not able to adapt the learning material to students with different backgrounds or levels of understanding.

In another study conducted in 2023, Maria Gonzalez and Alex Turner explored how generative AI combined with Natural Language Processing techniques can improve e-learning platforms. Their work demonstrated that AI can automatically generate summaries, quizzes, and explanations, which helps make the learning process more interactive and engaging. Their findings suggested that AI-driven personalization can play an important role in improving the overall effectiveness of digital education systems.

From the above studies, it is evident that although generative AI systems are still making great progress in course contents, most of the existing systems still require human intervention for completion. This creates a need for more sophisticated systems that can produce learning material with minimal human intervention, such as the AI Course Generator.

III. SYSTEM STUDY AND ANALYSIS

In many traditional e-learning platforms, creating course material is still a slow and labor-intensive process. Educators must manually design lesson structures, collect supporting resources, and arrange the content so that it makes sense for learners. This often leads to delays, inconsistent quality, and material that does not suit different learning needs. Since most courses on such platforms are fixed and predefined, every learner receives the same content regardless of their background or skill level, which limits personalization. In addition, multimedia elements such as videos or coding examples usually have to be added manually, increasing the workload and reducing efficiency. These systems also struggle to scale effectively, as they are not designed to support multiple users generating or modifying content simultaneously. Without intelligent automation, the platforms become less adaptable, which ultimately affects user engagement.

To overcome these limitations, our AI Course Generator introduces intelligent automation for creating structured and personalized learning material. Using the Gemini API, the system can quickly generate course outlines, chapter content, explanations, and even sample code based on the topic entered by the user. To improve understanding, the platform also suggests relevant YouTube videos for each module. Secure user access is handled through Clerk authentication, while Drizzle ORM manages data storage and allows users to save, update, and organize their generated courses. The interface is built using Next.js, React, and TailwindCSS to ensure that the platform remains fast, responsive, and easy to use across different devices.

As a result, the system meets several important objectives. It reduces the effort involved in manual content preparation, provides personalized learning material based on user input, and integrates suitable multimedia resources to improve understanding. The platform is also designed to operate securely while supporting multiple users. In addition, users can easily review and modify the generated course content whenever required. Overall, the AI Course Generator improves the efficiency, quality, and flexibility of digital learning when compared with traditional e-learning platforms.

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IV. SYSTEM DESIGN

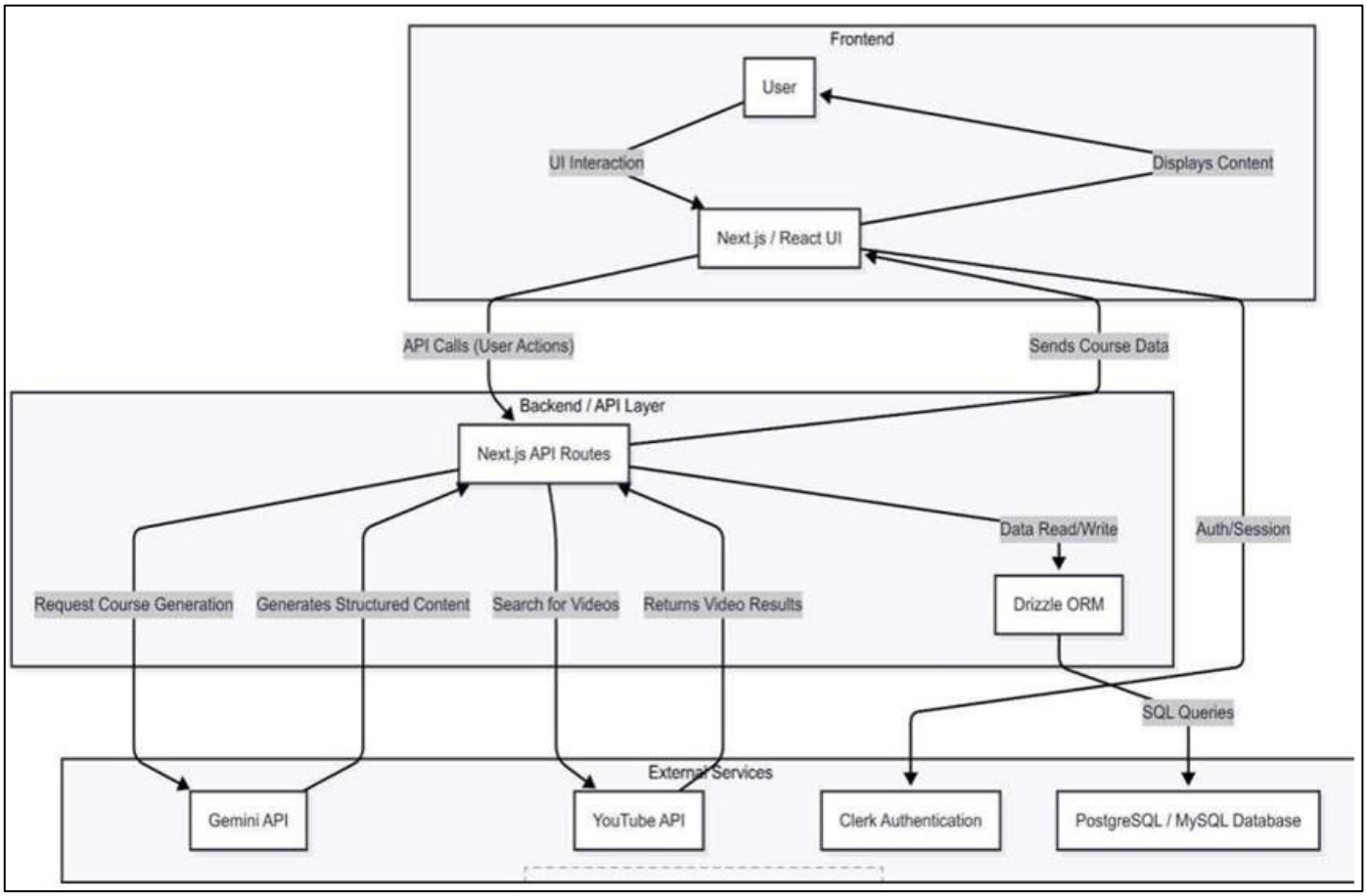

Fig 1 AI Course Generator System Architecture

The AI Course Generator follows a modular, layered architecture designed to maintain smooth data flow, scalability, and secure processing. Each layer in the system performs a specific function, and together they ensure that users can generate AI-based course content in a reliable and user-friendly manner.

The user interface of the system is built using Next.js, React.js, and TailwindCSS to provide a clean and responsive design. Through this interface, users can register, log in securely, enter their desired course topic, and view the generated content. The platform also includes a guided workflow that takes users step by step from selecting a topic to previewing the final course output, making the process simple and easy to follow.

Security within the system is managed through an authentication module that uses Clerk to handle user registration, login, and profile management. This mechanism ensures that only verified users can generate, edit, or store course content, thereby providing an important layer of protection for user data.

The central component of the system is the AI content generation layer, which is powered by the Gemini API. When a user provides a topic or course domain, this module produces structured, chapter-wise material that includes explanations, supporting information, and relevant code examples. This layer acts as the main intelligence of the platform, converting user input into organized educational content.

To improve the learning experience, the system includes a video integration module that connects to the YouTube API. This feature automatically fetches relevant educational videos for each chapter, allowing learners to understand concepts more clearly through visual and interactive explanations.

The backend and database layer of the system is implemented using Drizzle ORM to handle data storage and retrieval efficiently. It stores user details, generated course content, and related metadata in a secure manner while supporting multiple users at the same time. The information is maintained in a cloud-based PostgreSQL database to provide reliable access, better availability, and long-term data storage.

The output presentation layer is responsible for displaying the generated course content in a clear and organized manner. Through this interface, users can preview the material, make necessary edits, save it for future reference, or download it if required. This ensures that the final course output is easy to understand, properly structured, and ready for learning or sharing.

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V. IMPLEMENTATION

The AI Course Generator is developed as a full-stack web application that integrates the frontend, backend, authentication mechanisms, AI services, and external APIs into a single system. All these components work together to provide a smooth user experience, secure access to data, and dependable course content generation.

The frontend of the application is built using Next.js, React.js, and TailwindCSS to provide a clean and responsive interface. Reusable React components are used to design the homepage and navigation, making it easy for users to access features such as creating courses, previewing content, and viewing saved modules. The system includes a multi-step form where users enter the course domain and topic, and React state management updates the input in real time. After the AI generates the content, it is shown in a structured layout where users can review, edit, and store their courses. TailwindCSS helps maintain a consistent design and ensures the interface works smoothly across different devices.

The backend of the system uses Drizzle ORM to handle database operations in a secure and efficient manner. The database is structured with tables for users, courses, chapters, and related metadata, ensuring that chapter-wise information is stored properly with defined relationships. Basic CRUD functionalities allow users to create, view, update, and delete their course content as needed. Communication between the frontend and backend is managed through Next.js API routes, which help maintain secure and reliable data exchange.

User authentication in the system is handled through Clerk, which supports secure registration, login, and session management. This setup ensures that each user can access only their own generated courses, thereby maintaining both data privacy and personalized access.

The central functionality of the system lies in its AI and API integration. Once the user confirms the input details, the Gemini API generates structured course material that includes chapters, explanations, and sample code where applicable. To support better understanding, the YouTube API retrieves relevant videos for each module. The generated material is then displayed through a guided interface where users can review, modify, and save their courses conveniently. This overall workflow allows course content to be created quickly while reducing the amount of manual work required.

VI. SIMULATIONS AND RESULTS

To evaluate the performance of the AI Course Generator, we tested the system with multiple topics across different domains. The purpose of these tests was to check whether the platform could consistently generate clear, structured, and useful course material. The results indicated that the system was able to produce well-organized chapters, simple explanations, suitable examples, and relevant video suggestions for most inputs.

The generated content stayed consistent and understandable across different test inputs, indicating that the AI-based generation process is reliable. Feedback from users who tried the system showed that it helped reduce the time and effort needed to prepare course material. Additionally, the automatic inclusion of multimedia resources such as relevant YouTube videos improved both the clarity and overall quality of the learning content.

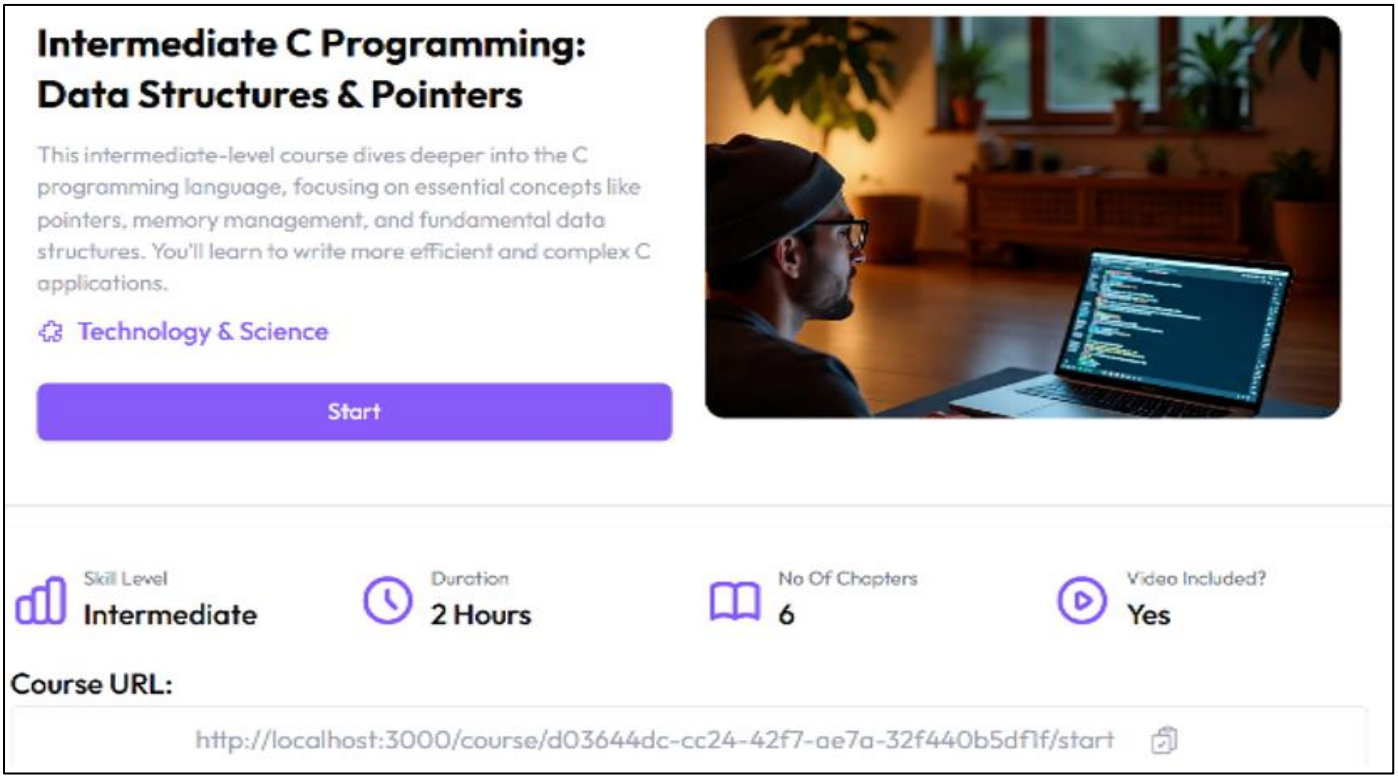

Fig 2 Creation of Course Layout

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We also observed that the system worked efficiently when multiple requests were processed, which shows that it can scale well and remain stable under usage. Overall, the testing results indicate that the AI Course Generator functions reliably, is easy for users to interact with, and helps improve both the efficiency and quality of digital content creation.

Fig 3 Accessing Generated Course Modules

VII. CONCLUSION

The AI Course Generator developed in our project shows how artificial intelligence can be used to simplify the process of preparing structured learning material. By combining modern web technologies such as Next.js, React, and TailwindCSS with backend tools like Drizzle ORM and Clerk, we were able to build a system that is both secure and easy to use. The integration of the Gemini API allows the platform to generate organized course content with chapters, explanations, and example code, while the YouTube API adds supportive multimedia resources that make the learning process more engaging.

This automated approach greatly reduces the time required for instructors to prepare structured educational material. It also helps maintain consistency in the generated content while allowing flexibility so that different users can adapt it to their needs. Overall, our AI Course Generator demonstrates how artificial intelligence can support modern digital learning by making course creation faster, more organized, and more personalized for both students and educators.

FUTURE WORK

There are several ways in which the AI Course Generator can be improved in the future. As artificial intelligence and natural language processing technologies continue to evolve, the system can be enhanced to become more intelligent and adaptive. Future improvements may include recommending courses to users based on their learning performance, automatically generating quizzes and assignments, and adding interactive assessment features. Additional enhancements such as voice-based interaction or guidance could also be introduced to make the platform more user-friendly and accessible.

The system can also be expanded by integrating it with Learning Management Systems (LMS) and cloud storage platforms so that it can be used more widely by educational institutions. Adding analytics and progress-tracking features would help monitor student learning and performance over time. Incorporating discussion forums or feedback modules could further improve interaction by allowing users to communicate and receive guidance in real time. With these enhancements, the AI Course Generator has the potential to grow into a complete AI-supported learning platform that makes the learning process more interactive and dynamic.

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