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Artificial Intelligence (AI) Driven Automated Learning Management System

Abbdullah Abbasi [a], Abdullah Zahid [a], Kashif Sultan [a,*], Ahmar Hafeez [a], Fatima Alam [b]

[a] Department of Software Engineering, Bahria University, Islamabad, Pakistan.
[b] Department of Computer and Information Sciences, Universiti Teknologi Petronas, Perak, Malaysia.

* Corresponding author: kashif.buic@bahria.edu.pk.edu.pk

Abstract:

Learning management platforms are widely used throughout educational institutes worldwide and have become an industry standard. These systems provide an easy way for students and teachers to communicate and disseminate information, but this can be a cumbersome task that takes up a lot of time and effort at the teacher's end. With the evolution in artificial intelligence, this system can be made intelligent, which could really help teachers and educators better manage their workload and maintain a better work-life balance while focusing more on students rather than creating quizzes and assignments. We are proposing a framework that solves all these issues by generating content required by educators and students, such as assignments, quizzes, and lecture notes, automatically, without putting in minimal to no manual effort. The proposed framework will undergo rigorous testing so its performance, usability, efficiency, and safety can be measured to make sure that the system is effective yet safe to use in a real-world environment.

Keywords: Learning Management Systems; Artificial Intelligence; Content Automation.

1. Introduction

Learning Management Systems (LMS) have emerged as pivotal tools in various educational settings, including schools, universities, corporate training programs, and online course providers. These systems are designed to streamline learning processes, enhance engagement, and improve learning outcomes.

An LMS offers a comprehensive suite of features that cater to diverse educational needs. AutoLMS is designed to aid the learning process and help both educators and students achieve better outcomes. The system is supposed to help them focus more of their time on the process of learning and gathering knowledge rather than having to prepare notes manually. This will help them focus more on what is being explained to them without having to multitask and write down everything, which takes students' attention from what is actually being explained to them.

For educators and teachers, this could help them prepare AI-assisted assignments and quizzes without having to manually prepare questions. This would minimize human error, and more human validation would be required only to check that proper assignments and tests are being prepared that cover all aspects of a specific topic. Students can take advantage of these features to better prepare and test their abilities by solving assignments and tests prepared by AutoLMS. The management features integrated into the system would help track the status of all the

students based on different metrics. They can track how much time students are spending on their tasks and what students are participating in class. This will help teachers better cater to students, which would in turn help both students and educators to learn more and teach in a better way.

Several studies have been performed highlighting how relating to complexities behind creating and managing content for educational purposes. A study conducted by Spante, M., Hashemi, S. S., Lundin, M., and Algers, A. in 2018 [1] found that different words mean different things to different people, and AI can help us cater to all people as modern LLMs are nothing but an amalgamation of world knowledge. Another study conducted by authors affiliated with the University of Duisburg-Essen in Germany [2] suggested that our classrooms need to be changed and made more flexible so that students can be more creative. By taking the workload off of the students we can help them think and understand more while another recent study done in 2024 by Krämer, B. J., Hupfer, M., and Zobel, A. [3] tries to find how our education system can benefit from modern AI technologies and the key take away from the study was how AI can be used to make courses much personalized to cater to different demographics.

By analyzing the aforementioned challenges and efforts, we developed an automated learning management system (AutoLMS). This powerful web-based artificial intelligence (AI)-driven tool has the potential to significantly reduce the time and effort required to develop comprehensive learning materials. AutoLMS will use concepts of Artificial Intelligence to provide personalized learning experiences tailored to people's needs and preferences, as discussed [5] and in Zhenxing Ge and Ying Hu [6]. Research suggests that efficient and effective implementation of technologies requires a balance between automation and human intervention, and the course creators play a crucial role in guiding and supporting students in learning processes, which is discussed briefly in [7]. In [8], the authors describe that future studies may be helpful in exploring innovative applications of Artificial Intelligence technologies and the best practices that include the application of AI technologies to build such learning management systems

The proposed framework (autoLMS) aims to improve the learning and teaching experience of course creators and students. By leveraging automation, content creators can focus more on enhancing the quality and relevance of educational content, rather than getting bogged down in repetitive tasks. One of the main focuses in the development of this project was to ensure that the generated content was closely aligned with learning outcomes and topics being taught, while covering all the aspects of those topics without going out the of bounds for any topics.

AutoLMS is an innovative platform that revolutionizes the educational content creation process by seamlessly integrating Artificial Intelligence (AI) technologies. Unlike conventional learning management systems (LMS) that rely on manual input or offer limited automation, AutoLMS introduces the following key contributions:

- **End-to-End Automation**: AutoLMS automates the entire process of educational content generation from content uploads to tailored material generation. This specific end-to-end functionality minimizes the need for manual intervention, unlike traditional LMS platforms.

- **AI-Enabled Natural Language Processing (NLP)**: The proposed system employs advanced AI techniques, including NLP models, to transcribe video content with high accuracy and generate a diverse range of educational materials, such as summaries, quizzes, and assignments. This capability is a significant improvement over generic transcription and content creation tools.

- **Customizability and Relevance**: Users can select specific content types based on their instructional needs, ensuring the generated materials are not only accurate but also contextually relevant and engaging for students.

- **Enhanced Accessibility and Efficiency**: By securely storing the generated materials on a centralized platform, AutoLMS allows educators to easily access and share resources. This streamlined workflow saves time and effort, enabling instructors to focus on improving their teaching quality.

- **Scalability Across Disciplines**: The modular design of AutoLMS allows it to adapt to diverse academic disciplines and teaching formats, making it a versatile tool for educators in various fields.

2. Literature Review

A Learning Management System (LMS) is an umbrella term often used to describe diverse systems that deliver online educational services to students, teachers, and content creators. Essentially, an LMS encompasses a variety of platforms that structure and facilitate access to online learning resources for students, educators, and administrators. Typically, these platforms include essential features such as restricted access for authorized users, various types of learning content, and multiple communication tools [9]. The fundamentals of LMS have been thoroughly discussed in [10], [11]. In [12], the authors have identified some limitations in a traditional learning management system

Initially, Coursera [13] emerged as a pioneering force with its AI-integrated chatbot, Coursera Coach, which operates in a manner akin to AutoLMS. This sophisticated chatbot is engineered to assist students by addressing their queries pertinent to their ongoing courses on the platform. Building upon this innovation, AutoLMS was developed to further support course creators on platforms such as Udemy [14] and Coursera by streamlining and automating documentation tasks, thereby enhancing the efficiency of the course creation process. Figure 1 shows the interface of the Coursera coach.
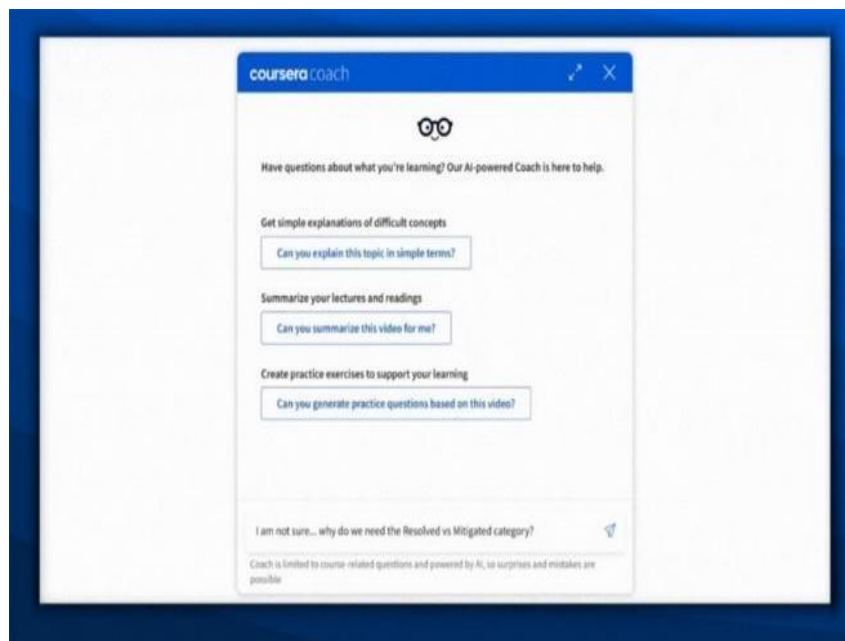

Figure 1: Coursera coach

While Coursera and Udemy offer tools for course creation, they often require instructors to invest substantial time and effort in manually generating educational resources. Coursera's AI-driven features primarily focus on aiding students, rather than automating content creation for instructors. AutoLMS, on the other hand, bridges this gap by leveraging powerful AI frameworks like AssemblyAI and OpenAI to automatically transform video lectures into text and generate a wide range of educational resources. This significantly reduces the manual workload for content creators, providing a more efficient and streamlined solution compared to the current offerings of Coursera and Udemy. Subsequently, BitDegree [15] made its entry into the online education sector as a groundbreaking platform. As a Web3-based system, BitDegree primarily focuses on imparting knowledge about cryptocurrency and Web3 technologies. It employs a unique learn-and-earn model, offering incentives to users as they acquire knowledge about Web 3.0.

Furthermore, Khan Academy [16] has distinguished itself as one of the premier educational platforms. It offers a seamless and comprehensive environment for both learners and educators to engage in a variety of educational activities, thereby significantly enriching the online education landscape. Table 1 summarizes the key findings and limitations of some recent studies related to LMS.

Table 1: Key findings and limitations of existing work

Ref #	Year	Key Findings	Limitations
5	2021	Artificial intelligence techniques can be used to provide personalized learning experiences to learners.	Only addressed the innovation that automation can bring to the education sector without going into the depths of the AI technologies.
6	2020	Use of AI and ML models to leverage learning management systems.	Only suggested the tools and technologies for bringing innovation through AI and ML without going into details of the implementation of the technology.
7	2020	Study of AI technology that will help in bringing innovation to the online education system.	No technologies that can automate the process of creating educational resources were studied.
8	2020	Future studies might be helpful in exploring AI technology to leverage learning management systems.	Purely based upon hypotheses.
11	2020	A thorough study of the functionalities and behavior of learning management systems.	Need for manual writing of educational resources.
12	2020	The usefulness of learning management systems.	Highlighting the COVID-19 pandemic, addressed only distant learning.
17	2020	An overview of a learning management system.	Studied the architecture of the learning management system, but didn't go into much detail.
18	2023	The study revealed that most Indonesian university students viewed Learning Management Systems (LMS) as advantageous for improving access to learning materials and communication.	The research limitations include small and possibly non-representative sample sizes, dependence on self-reported data, and context-specific findings.
19	2023	The study highlights AI's transformative potential in enhancing personalized learning, automating assessments, and streamlining education workflows.	Faces challenges such as data privacy concerns, educator adaptation, and scalability limitations across disciplines.
20	2024	This study highlights the significant role of Learning Management Systems (LMS) in enhancing educational quality through innovative teaching methods.	The potential lack of generalizability of the findings and challenges in implementation.

3. Proposed System Architecture

Our proposed system (autoLMS) follows a client-server model where the web-based user interface (client) interacts with the server-side components responsible for processing, data management, and

This block diagram illustrates the key components and operations of AutoLMS, a tool designed to streamline educational content creation
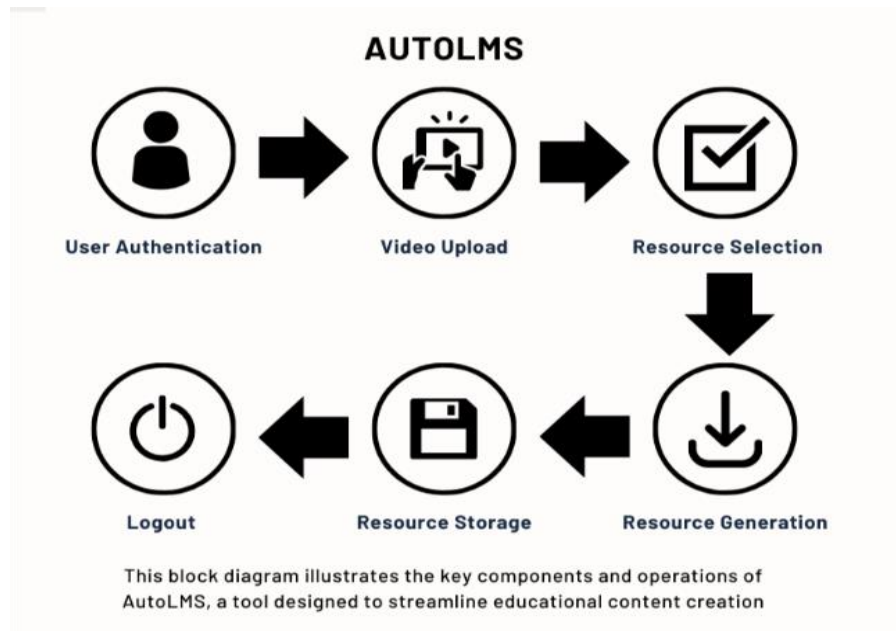
Figure 2: Proposed system architecture

for external API integration. This separation enhances maintainability and supports concurrent user interactions. Figure 2 depicts the architecture of the proposed system.

The proposed system (AutoLMS), as shown in Figure 2, offers a comprehensive suite of features designed to streamline the educational content creation process. Content creators begin by authenticating their accounts, ensuring secure access to the platform. They can then upload lecture videos, which AutoLMS processes to extract educational resources. Content creators can select the specific types of resources they need to generate, such as summaries of the content, key points, lecture notes, quizzes, and assignments from the content. After the generation of the desired resources, these resources are stored within the system for easy access and management.

What sets AutoLMS apart is its use of cutting-edge Artificial intelligence and natural language processing techniques. There are existing systems, such as Udemy, that provide users with knowledge resources, but since the workflow of AutoLMS is fully automated, it opens up the doors for much smoother and easier documentation of lectures.

3.1 User Authentication

The CLERK suite was used for user authentication and management. The CLERK suite provides method and technology that helps provide users with a secure environment while making it easy to manage all users. We utilized their user authentication SDKs that are seamlessly integrated into the system to ensure that user data and profiles are secured and unauthorized access to user profiles is restricted in the safest way possible.

3.2 Content/Video Upload

AutoLMS was developed using NEXT.js due to its efficiency and ease of development. This framework provides features like server-side rendering and dynamic routing, which make it easier to develop complex systems while also achieving the best user experience. For styling and components, we utilized Shaden UI kits, which provide easy-to-integrate components that follow the industry standards for human-computer interaction while providing flexibility to style everything in your unique way. Using these technologies, we developed a system that was intuitive and easy to use for a relatively novice user.

3.3   Resource Selection

Using the NEXT.js and Shaden components in autoLMS offers several alternatives. The instructors and content providers can select the choices they want for content development. Users may easily identify the kinds of learning materials they require, including summaries, key points, lecture notes, tests, and assignments, with this interface. Further, an option is provided for content creators/ instructors to enter the prompt that allows them to enter prompts about any other educational resources they wish to generate that are not covered by the existing checkboxes. This dynamicity ensures that content creators will fully customize the output to meet their educational requirements.

3.4   Resources Generation

After selecting the desired contents, autoLMS generated these contents by employing several technical steps. Initially, TypeScript is employed for scripting purposes, ensuring robust and scalable code. In autoLMS, we used AssemblyAI, which used the state-of-the-art AI models for transcription. The uploaded video is converted into transcripts using AssemblyAI, which accurately transcribes the audio content into text. After generating text from the video, the text is passed to OpenAI, which generates the required educational resources, such as summaries, key points, lecture notes, quizzes, and assignments, based on the extracted transcript. Hence, with an AI-driven framework, high-quality desired contents are generated efficiently.

3.5   Resource Storage

In our proposed system (autoLMS), all the generated contents are stored in a project, which will have a specific name provided by the content creator/instructor. In this way, content creators/instructors will easily access and manage their generated content. MongoDB (database) is used for data storage, which is a document-oriented database known for its flexibility and scalability. When content creators/instructors want to view their recently created resources, autoLMS will efficiently retrieve this data from the database, allowing quick and seamless access to their educational materials. So, through this process, all generated resources are securely stored and easily available whenever required by the content creators.

3.6   Logout

For content creators' data protection, a logout option is provided in autoLMS. As content creator log out from the autoLMS, their sessions are securely terminated, preventing unauthorized access.

4. Experimentation and Results

The primary objective of the experiments was to analyze the efficiency and accuracy of AutoLMS in educational content creation. The experiments are conducted by running the application and providing distinct inputs to test each functionality comprehensively. The presentation of results is shown and explained in the subsequent text for user authentication, video upload, content generation, and content storage.

AutoLMS's user authentication system, powered by CLERK, was thoroughly tested to ensure secure access to the platform. The results are shown in Figure 3.

The transcription API, powered by AssemblyAI, was tested to ensure accurate conversion of video content into text transcripts, as shown in Figure 4. Results indicated a high level of accuracy, with minimal errors in transcribing.

The responses from OpenAI, used for generating educational resources shown in Figure 5, from the transcripts, were evaluated. The produced materials exhibited pertinence and consistency with the input audio transcripts, signifying a proficient use of the artificial intelligence model.
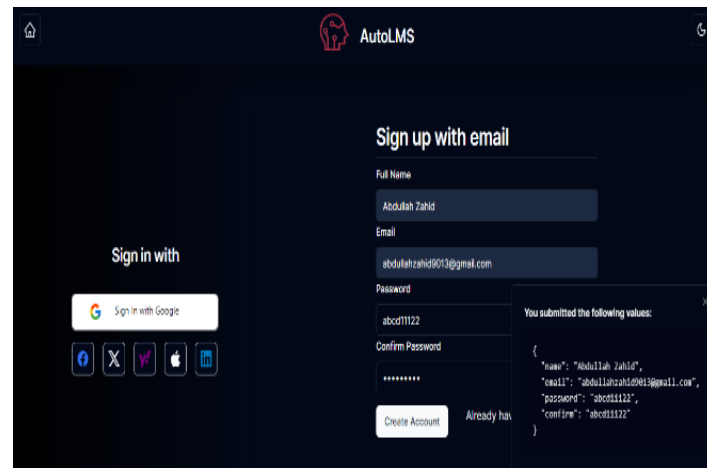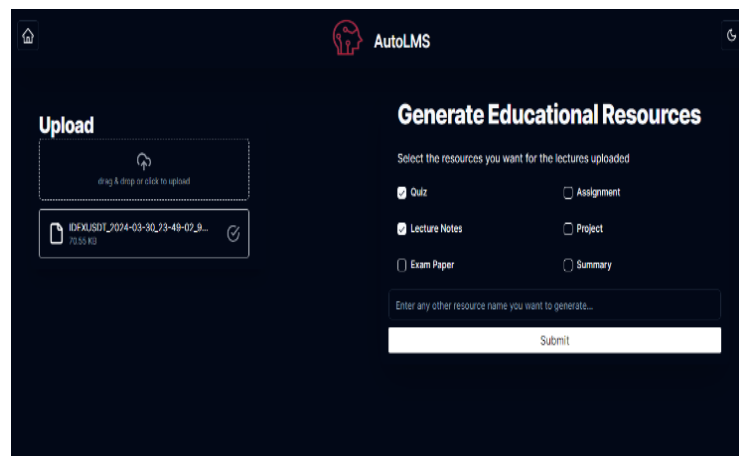
Figure 3: User authentication module

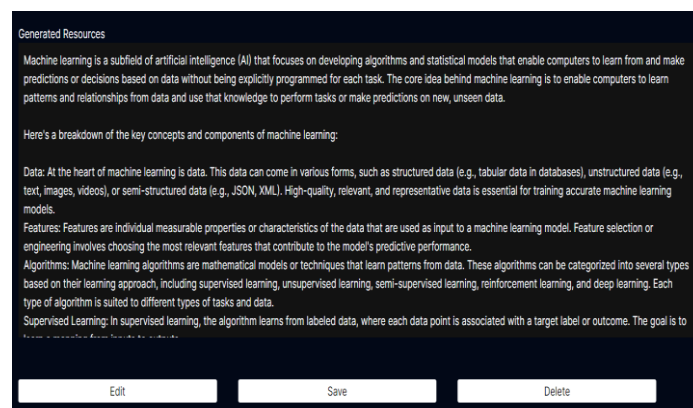Figure 4: Content/Video upload module

Figure 5: Content generation

The system was tested for different types of educational content for multiple levels of complexity. The generated content was evaluated for catering to the complexity of a specific topic and at what level it was being taught. The database was tested and optimized for more data retrieval. The sensitive data was stored in encrypted form for improved safety.

The AI-generated contents were tested by using manual evaluation and course material prepared by actual instructors and teachers. The user management and authentication were done using CLERK to

provide a secure and smooth experience to our users. The CLERK suite provides a tool for the management and authentication of users. The accuracy of Assembly AI was tested by comparing transcripts generated by the system against human-generated transcripts, and we also compared transcripts generated by numerous other AI systems. Assembly AI came on top in both accuracy and efficiency. The content generated by OpenAI's GPT was tested for consistency on various topics and complexities. MongoDB was used as a database, and this was decided based on the type of data that was supposed to be stored for our system, and the scalability and efficiency provided by MongoDB would help scale the system consistently.

5. Conclusion

This research paper aims to present a system, "AutoLMS," which leverages SOTA AI technologies to make groundbreaking changes to the existing learning management systems by automating the tasks for both educators and students to help them focus more on the learning process. This study covers technical aspects of the system, including the development, while also discussing how the system performs in a real-world environment under different parameters. This work discusses how this system can help take the extra workload away from students and educators, such as taking notes and preparing assignments, quizzes, and exams. AutoLMS can help students learn in a more flexible way, which in turn would help them think in a more creative manner, which could lead to substantial development in traditional educational pathways. The system helped students and teachers give more time to communicating with each other and understanding the concepts, rather than having to perform the cumbersome tasks of generating content and managing course material.

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