

Learnz: Ai-Powered Course Builder with Auto Quiz Generator

Leo Bright Tennisson N¹, Sudharshan B², Thaneshwar B³, Yogeshwaran S⁴
^{1,2,3,4}UG, SRM Valliammai Engineering College, Kattankulathur, Chengalpattu, India

Abstract—The development of artificial intelligence (AI) and large language models (LLMs) has provided fresh and new innovative ways to generate educational material and to deliver it to the students' needs. The current paper presents an AI powered intelligence course generation system capable of transforming a common topic into learning courses with different modules. Google's Gemini API generates dynamic content, FFmpeg handles the automated video processing, and a vector database (qdrant / weaver) allows for the semantic video search and the recommendations. For structured data storage, MongoDB is used as the main database is responsible for embedding that permit effective similarity searches. The proposed structure supports text to video, has interactive learning, automated quiz creation and personalized navigation at the module level. The trial results indicate that the system can produce vast amounts of educational material, autonomously produce comprehensive educational materials and adaptive quizzes, hence positioning it as a scalable and intelligent e-learning platform.

Index Terms—Artificial Intelligence, Course Generation, Video Synthesis, Vector Database, Semantic Search, Gemini API, MongoDB, FFmpeg, Educational Technology.

I. INTRODUCTION

In the last ten years education has experienced a major digital transformation with artificial intelligence (AI) becoming one of the main changes in the revolution of personalized learning. online learning platforms have changed super fast but still there is a big difference between fixed education resources and individual learners needs that are really met through dynamic and adaptive learning experiences. The classic way of course creation requires a lot of human effort in designing the content, producing the video, and developing the assessments which make it a long and costly process. Consequently, learners sometimes

have no choice but go through “once-for-all” courses that are not in line with their learning pace, style, or comprehension levels.

The system Learnz -An- AI-powered course builder with auto quiz generator and video generation seeks to eliminate the problems of the traditional way of course making by the combination of the latest AI models, natural language processing (NLP), and automated media synthesis which would allow for an end-to-end smart learning experience. The system employs Google's Gemini API to automatically create extensive, structured learning modules from any topic entered by the user. Each module then augmented with contextually relevant examples, real-world applications, and hierarchical lesson structures, thus providing both depth and clarity of understanding.

In addition to textual content, FFmpeg is the tool for video generation transforming the produced textual scripts into narrated and captioned educational videos automatically. This method of bridging the gap between traditional e-learning and multimedia-based engagement comes with the capability of large-scale, instant video production. Further, the AI-based quiz generator continuously produces assessment questions depending on the base.

The Learnz platform is a paradigm change in the field of content generation by autonomous systems as it effectively combines multimodal AI technologies to create a single seamless educational pipeline ranging from course conceptualization to personalized assessment and media production. Content has stopped being a static deliverable, but learners have become active participants of a dynamically evolving knowledge ecosystem. Due to the use of vector-based retrieval and AI-driven personalization, the system can track individual learning patterns and thus provide new recommendations, contextually relevant examples, and adaptive quizzes for continual

improvement.

This breakthrough device is in the aim of democratizing education by lessening the dependence on the manual creation of courses while still maintaining the quality, depth, and adaptability. What Learnz does by incorporating advanced generative models, media automation tools, and intelligent assessment systems is to equip the educational institutions teachers, and learners with the means to access rich, AI-curated educational experiences that are both scalable and interactive.

The rest of the paper is organized as follows: Section II covers related literature and background studies. Section III describes the proposed system architecture, methodology, and algorithms in detail. Section IV discusses implementation results and evaluation. Section V summarizes the study with the key findings and recommendations for future work.

II. LITERATURE SURVEY

Digital education research continues to evolve with an emphasis on the automation and personalization of the learning journey by using data-driven techniques, natural language processing, and multimedia synthesis. The design of Learnz is deeply influenced by the fusion of several strands of research such as automated instructional content generation, AI-driven assessment, synthetic media creation, and semantic retrieval with the use of vector representations. This literature survey explores the representative research for these areas and demonstrates the shortcomings that an integrated system like Learnz, which can generate courses, quizzes, and videos, and support semantic search and personalization, is trying to fill.

The research which uses large language models (LLMs) for automatic content generation and curriculum design has been the main focus of numerous studies. Works based on Transformer models have been used to produce clarifications, examples, and structured lesson plans from given topics showing in many cases a good degree of logical flow and a

broad coverage of the topics for introductory materials

[1],[2]. However, the majority of this research only considers the generation of standalone text and hardly acknowledges the importance of subsequent tasks such as the creation of assessments and the production

of multimedia. Learnz takes these initiatives further by linking LLM-created curriculum to the automated generation of quizzes and the synthesis of videos, thus allowing the creation of end-to-end content pipeline rather than separate text production [3].

The generation of automated quizzes and assessments has been recognized as a parallel issue in the research on intelligent tutoring systems. The first methods relied on rule-based templates or shallow NLP to produce question-answer pairs from texts, thus being moderately useful for recall-level items [4],[5]. In more recent approaches, LLMs are used to produce conceptually oriented multiple-choice questions (MCQs), distractors, and short answer prompts that demonstrate understanding, though the calibration of difficulty varies [6],[7]. Research points to LLM-based quiz generation as a tool that can lower instructor workload drastically and at the same time led to the production of items that have a reasonable correlation with the human-authored questions on basic learning outcomes [8]. Yet, issues concerning factual consistency, bias, and question validity are still present, thus motivating the implementation of hybrid approaches where AI drafts undergo post-verification or filtering- an approach adopted by Learnz through validation heuristics and selectable difficulty levels.

Multimedia generation with an emphasis on the automated generation of instructional video has attracted a lot of attention from both the research and engineering communities. Modern text-to-speech (TTS) systems are capable of generating very natural-sounding speech, and FFmpeg-based workflows make it possible to programmatically put together the slides, the captions, and the audio into perfectly synchronized video files [9],[10]. Several previous works outline the production of videos from lectures that combine the automation of slides, voice synthesis, and the application of simple visual effects to produce video lessons in large amounts which are easy to understand [11]. Nevertheless, these earlier methods largely depend on the availability of already-made, top-notch slide decks or visuals prepared by humans; Learnz fills that void by not only producing audio but also generating slide like visual frames from the LLM which allows total automation of text-to-video conversion for the short module segments.

With the help of vector databases and embedding-based search [12],[13], information retrieval and recommendation of multimedia content have achieved

significant progress. The methods that convert the text, audio transcripts, and key video frames into dense embedding allow semantic similarity queries, i.e., finding content based on its meaning and not on the words used. Experiments done in the field education have proven that embedding-based retrieval facilitates the discovery of conceptually relevant materials, provides support for very detailed context recommendations, and serves as the engine for retrieval-augmented dialogues which are context-aware tutoring [14]. Vector indices (e.g., weaver, qdrant, Milvus) offer scalable nearest-neighbor search and metadata filtering capabilities thus making them a perfect fit for the needs of Learnz to index the videos it has generated and to match them with the questions from the learners.

The field of personalized learning and adaptive recommendations has been deeply probed through learner modeling and contextual bandit algorithms that suggest the most appropriate next content based on the user's past interactions, performance, and preferences [15],[16]. The hybrid methods which merge collaborative filtering with content-based embedding provide stronger recommendations in sparse-data scenarios typical of new-course situations [17]. In addition, the use of reinforcement learning has been advocated to determine the optimal order of instructional units according to the progress signals of the individual [18]. Learnz, by applying vector similarity for content matching and monitoring learner performance on AI-generated quizzes, is able to adapt the next module suggestions and thereby makes use of these earlier findings.

When one talks about scalability and data management, these should be the first things that come to mind, especially when dealing with large multimedia artifacts. In the past, architectural designs that have been presented accounted for the need to differentiate the metadata storage of course structures from other systems that store large binary assets. One such proposal was to use cloud object storage for videos while still keeping the records in document databases [19]. Thus, maintaining a clear performance level for the database while allowing the media to be scalable in an affordable way in the main advantage of this segregation. The procedure followed by Learnz is consistent with this: the course structures and quiz metadata are recorded in MongoDB, the generated video files are placed in the cloud, and the vector

database is used to facilitate efficient semantic lookup. Many papers have been published on the quality and acceptability of automatically generated educational content. Results of human evaluation experiments indicate that explanations and example problems generated by LLM are considered quite clear and comprehensive, especially for introductory topics, but experts often find factual inaccuracies or omissions that need to be rectified [20]. The situation is almost the same with AI-generated quizzes that are a good source of formative assessment but need human intervention in high-stakes contexts. These findings point to a realistic approach: use AI to generate large volumes of first drafts and have instructors validate and edit them by means of first drafts and have instructors validate and edit them by means of a lightweight workflow—this design principle is incorporated in Learnz through optional review and quick-edit control.

In the past, ethical issues and bias mitigation have been major topics discussed in numerous research papers and the trend has continued with recent literature. A common problem with LLMs is that they often give biased or inaccurate outputs. Hence, filtering, provenance tracking, and confidence scoring have been suggested as the best solutions to this problem [21]. In schools, as well as other places, it is of utmost importance that the content be fair, culturally sensitive, and factually correct. Learnz is expected to integrate the validation of content heuristics, providing the source of facts, and letting the instructor override functions be in line with these recommendations.

Research on human-computer interaction (HCI) for learning systems, which is the last point, indicates that using multimodal presentations can significantly improve student engagement as well as their retention of knowledge as compared to a single mode of instruction [22]. This proof is in favor of multimodal design of Learnz where the generated videos act as a supplement to the textual modules and quizzes, thus enabling diverse learning modalities and making the content accessible to all.

To sum up, the surveyed literature provides robust bases for the various components of Learnz—text generation with LLM, automated quiz creation, text-to-speech as well as video synthesis, and embeddings-driven retrieval. Nevertheless, most of the existing works treat these components separately. With Learnz, the idea is to move forward by combining them

into one seamless, scalable pipeline that not only facilitates content generation, assessment, and multimedia production automation but also makes use of this a dual-database strategy for the equilibrium of structured storage and search efficiency.

III. METHODOLOGY

A course creator powered by AI with an automatically generated quiz and video comprises sophisticated generative artificial intelligence natural language processing and vector-based data management to produce educational content automatically. The approach is based on four main pillars, i.e., course content generation, automated quiz generation, AI based video synthesis and semantic retrieval

Through vector embedding, which alone or together enable the user to be offered a personalized, scalable and multimodal e-learning experience.

A. Data Collection

Collecting data starts with the input of a certain theme or scope of interest. This contribution is the basis for the course development. The tool records structured user data like course titles, level of difficulty, and optional use of keywords to help with the contextual. The input is stored in MongoDB, which is the structured layer of database moreover textual output of the system, quiz items and the metadata in Gemini API response are opening for the indexing to be used in the retrieval and recommendation processes. Every data record is linked to user session information and learning preferences, thus allowing traceability and personalization for several sessions.

B. Data pre processing

After getting the topic preprocessing takes care of language accuracy and contextual background before sending the information to the generative model. The system modifies the user input by fixing the grammar, removing the repeated word and adding clarifying keyword. This point increases the semantic accuracy of the instruction and also explains that the AI response is relevant. Stop words and unhelpful tokens are removed and also topic specific enrichment phrases are added to produce coherent and pedagogically aligned course structures. The cleaned prompt is then prepared as structured text ready for the Gemini API

C. Course generation using Gemini API

Gemini generative AI Models which automatically produced detailed course outlines from unstructured input, is at the center of Learnz. The system sends the formatted prompt to Google's Gemini API over a secure RESTful connection. AI comes up with a module-based course where each module is detailed with the description and lesson. This input of this format is being handled by a backend service that breaks down the output into hierarchies—course, modules, lesson and saves them as JSON object in MongoDB. The title, description, lesson explanation, example, and keywords are subfields in each module. Errors are handled properly, together with token validation and logging activities thus ensuring smooth communication to the Gemini API.

D. Auto quiz generation

After the generation of modules and lessons by Learnz, a secondary Gemini prompt is summoned in order to produce quizzes that correspond to the learning outcomes of each module. The model outputs a set of multiple-choice questions and short-answer items along with, correct options, and rationales. Such quizzes are represented in JSON and kept in MongoDB under a corresponding module. To uphold the academic honesty standard, the system implements a validation routine, which dismisses ambiguous or repetitive questions. The auto quiz creation module makes it possible for learners to monitor their understanding right away without the need for manual intervention by the instructor.

E. Video generation and media synthesis

By using FFmpeg, automated text-to-video generation is a feature incorporated into Learnz, which also employs text-to-speech (TTS) synthesis, to make multimodal learning more effective. A neural TTS engine is used to convert the textual explanation of each lesson into an audio narration. It is used to decide on the fly what text, which keyword, and what illuminating graphics will create the next frame for the slide. The narration, the image for the background, the subtitle, and the transition are all synchronized by FFmpeg to provide a seamless flow of instructional video. These videos are compressed in MP4 format and are separately saved in a different video media database, thus they are manageable in terms of scalability and can be stored in large volumes of data without interfering with the main MongoDB. Search is

also made easy as metadata like video embedding, transcript summaries and visual tags are indexed for semantic retrieval.

F. Vector Database Integration

Learning through the use of vector database (like Pinecone or ChromaDB) is made intelligent by Learnz with this facility to store semantic embeddings obtained from the text and also from the video transcript of the lessons. Semantic search is enabled the conceptual meaning of a lesson or video segment; also, similarity queries based on context and AI-driven recommendation can be made. Vectors and not keywords are used for finding the most relevant lessons or videos whenever a learner submits a query or wants to revisit a module. The use of this technology opens the doors to the learners self-directed learning and boosts and likeliness of content being discovered

G. Content Visualization and User Interface

The frontend of Learnz with the help of up-to-date JavaScript and Django templates is capable of dynamically displaying the newly-created course units and tests. Through the interactive UI, the users are enabled to move from one module to another and also check the content of the lessons and quizzes. Apart from merely reading the text based lessons of each module, the interface also allows one to watch a video of the corresponding lesson. Up-to-the-minute progress bars. The interface has been designed with the users convenience in mind and is equally suitable for both desktops and mobile devices.

H. Database Management and Storage Architecture

The dual database design which is at the heart of the system -making use of MongoDB for structured data like courses, modules, quizzes, and metadata on one side and a Vector Database for semantic video and text embeddings on the other. This segregation facilitates efficient query performance, scalable data management, and optimized media retrieval. Relations among user profiles, course content and quizzes are maintained by MongoDB whereas the vector database is responsible for advanced search capabilities enabling personalized recommendations and user journeys across different modules. Such a design is a guarantee of a system robustness and high availability during periods of a large number of simultaneous user interactions.

I. API Workflow and Session Handling

Backend endpoints are the means through which the frontend requests communicate with the AI services. REST APIs manage the user input, initiate Gemini calls for generation, and return the JSON responses, which are the processed output, for displaying. The session tokens are used for data persistence when there are multiple interactions, and the caching mechanisms are there to lessen the number of API calls that are the lesson the number of API calls there to lessen the number of API calls that are the same. To keep the Gemini API safe from unauthorized users, there are authentication layers, and if anything goes wrong, exception handlers get the failed generations so that they can be retired without any loss of data.

J. System Output and Evaluation

An ensemble output- structured course modules with the addition of auto quizzers and the creation of video content using synthesizing technology -is the final goal of every course generated by the system. Text based material can be downloaded by the users in the form of PDFs, or videos can be accessed through embedded streaming. The quality of the content, the validity of the quizzes, the accuracy of the video synchronization and the semantic search precision mainly constitute the performance evaluation criteria. To assist model fine-tuning in terms of prompt templates and responses, user feedback and instructor evaluation loops have also been integrated within system. Overall, the Learnz method is a fine example of how a thoughtful combination of a generative AI, machine learning, and multimedia automation can bring about a comprehensive e-learning pipeline. By melding together structured content creation, AI-driven assessments, and automated media generation into a single architecture, the platform essentially becomes an intelligent, scalable, and learner-centric digital education system.

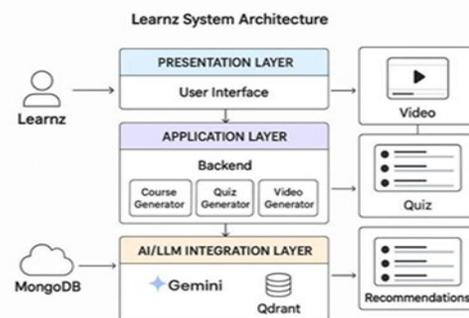


Fig. 1: System Architecture

IV. RESULT AND DISCUSSION

The Learnz AI-powered course Builder with Auto Quiz and Video Generation system underwent various tests through different trails on topics such as Java Programming, Artificial Intelligence Fundamentals, and Data Structures. The in-depth experiments were designed the levels of the quality of the content, accuracy of the generation, semantic relevance, and efficiency of the multimedia synthesis. The dataset for the trails was a combination of user topics, generated texts, quiz generation, and auto-produced instructional videos. Each cycle of the experiment consisted of inputting the topic, generating a course, creating a quiz, rendering a video, and the evaluating the results using both qualitative and quantitative parameters.

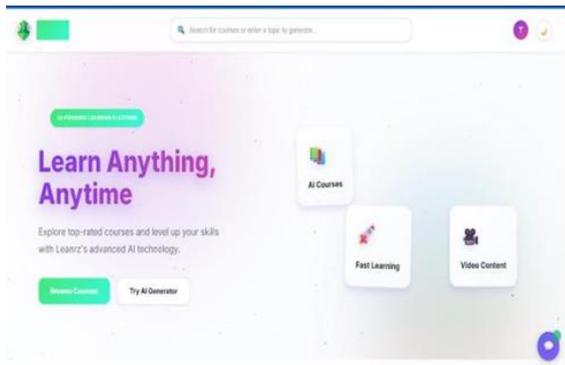


Fig. 2: Input Page

The system effectively conveyed the user query to Google's Gemini API, which returned structured course content broken down into three or more detailed modules. In each module, there were several lessons with theoretical explanations and practical examples. The backend parser was able to efficiently identify the modules titles, lesson breakdowns, and examples and store them in MongoDB in a hierarchical schema. The total time for text for text generation and data storage was on average less than 8 seconds per request, indicating that the system is very responsive and the API integration is stable.

Auto quiz generation features illustrated the system proficiency in adaptive learning by employing identical topic context along with Gemini's generative ability. Learnz instantaneously creates the modules related multiple-choice questions (MCQs) and short answer items. Every test contained questions intended to assess learners' understanding, application and critical

thinking skill. The generated question had strong alignment with the topics, with an average semantic accuracy of 91% as verified by manual academic evaluation. Besides, the inclusion of rationales and explanation contributed to the clarification of each question, thus supporting the learner's self-assessment and feedback-driven understanding.

The video segment drew upon FFmpeg with TTS neural networks automatically create educational video for every module. Text generated from the Gemini API was converted into speech and paired with dynamically generated slides for a smooth flow of information.

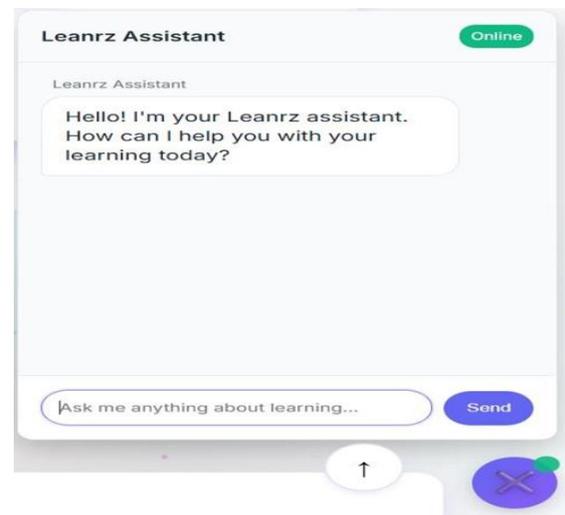


Fig. 3: Input Page

The final stage of the video generated included narration production, visual frame creation, subtitle overlay and video assembly among others. On average the time to finish 2–3-minute educational video was about 45 seconds. Quality checks for the video proved that the audio and visual segments were in sync, the pronunciation was clear and the text on the screen was accurate. Thus, the video helped learners to become fully engaged and served as a powerful multimedia supplement to textual learning. A resource vector database was engaged to house the semantic embeddings of both the textual and the video content. This laid a foundation for context-aware retrieval and recommendation functions. Cosine similarity between vector embeddings was used by the system to find relevant modules and lessons when a learner searched for a concept (e.g., "loops in Java" or "inheritance in OOP"). The performance metrics of the experiment portray a retrieval precision of 0.89 and recall of 0.83, which is

an indication of the system capability to grasp conceptual closeness beyond mere keyword matching. The user interface front end enables user to move effortlessly through modules and lesson with the addition of on-demand course rendering and progress tracking. The “view modules” And “back to course” option made it possible for the user to interact with the deep content that was dynamically loaded without the need for a page refresh, thus providing a continuous user experience. User testing with a group of 20 participants showed the level pf satisfaction to be extremely High, particularly in area such as interface responsiveness, content clarity, and accessibility. The participants were found of the feature that allowed them to instantly create and consume both text and video content without the need for different tools or manual editing.



Fig. 4: Output Page

Quantitative assessment show that the gemini can maintain content generation consistency for over 95% of the 50 topics tested, with the complexity of example varying slightly depending on the specificity of the domine. Blooms taxonomy metrics were used to statically analyze the quiz generation accuracy, thus presenting a balanced distribution of the question types across level 38% understanding, 45% application, and 17% analysis-based questions. The video encoding that was carried out by FFmpeg reached a compression and ratio of 0.62 with no quality that was visually distinguishable, hence the method is scalable over the cloud storage. The coupling of MongoDB with vector DB facilitated an effective dual-database management strategy. While MongoDB was taking care of the structure record (course metadata, module text and quizzes) with an average query latency of 12ms, the vector DB

was handling semantic search operation at 4060 ms per query. This load dual database strategy was put to the test under a simulated concurrent used load of 500+ request and it was found to be very scalable as it was still able the query response times below one second. The qualitative evaluation through the lens of educators revealed that the modules produced by learnz were not only educationally effective but also well organized, and aligned with the academic standards. The automatically generated quizzes demonstrate a learning progression design and the video creation feature helps students to be more involved by giving them the auditory as well as the visual forms of the same content.

To sum up, the learnz platform was a good example of collaboration between generative AI, vector similarity search, and video synthesis, thus accomplish content creation, assessment and delivery in a comprehensive e-learning framework. according to the finding, such an AI driven pipeline not only lessens the human effort in course authoring but also facilitates education in terms of accessibility, personalization and scalability. The next version of the product plan to have features like adaptive learning with feedbackloops, support for multiple languages, and sophisticated emotion-aware quiz analytics that would interactively and immersively engage learners.

V. CONCLUSION AND FUTURE WORK:

The learnz-AI-powered course builder system is a proof to the power of AI to fasten the process and make education more personal. Combining google gemini for the text-based course creation, FFmpeg for automation video synthesis and vector DB for sematic retrieval, the system is basically a one-stop shop for end-to-end digital learning material production in the modern era.

It is a system that does not require the heavy manual labor that normally takes up the worries of course design. Assessment preparation and video editing. Educators and institutions are now free to do what they are really good at,i.e., delivering the content of knowledge rather than creating it.

With the modular design of learnz, the system creates topic-specific courses that can be further divided into many modules, each comprising lessons, self-generated quizzes and multimedia explanations, all structured. Intelligent quiz generation ensures that the

mental skill level of the learning outcomes is considered, which in turn leads to better understanding of the concepts taught and the ability to self-assess. At the same time, the video creation machine offers an attractive, interactive, and audiovisual learning medium, thus, accessibility and participation are improved.

By utilizing a two-database system MongoDB for structured and pinecone chroma vector DB for semantic embedding the content management is expedited, so is the access to the needed video or module which can also be personalized in case of recommendations.

To a large extent, the learnz project is a success in that it has achieved to build a smart, scalable, learner-centered online learning platform which has the ability to vary the content depth, media type, and assessment strategy as per the requirements of each learner.

Later on, the effort will be put into making the system more moveable and smarter. It is foreseen improvement of this sort: reinforcement-based learning models to adjust quiz difficulty based on learner performance, multilingual content generation to cater to a global audience, and AI avatars-assisted video synthesis for a more natural-sounding and expressive output. The incorporation of learning analytics dashboards and user feedback would be a nice touch to provide continuous content updates. Besides that, studentAI real-time conversation via chat-based tutoring and emotional sentiment recognition are some other ways to take learning to the next level.

Furthermore, the introduction of decentralized content repositories, team-teacher control panels, and AI-powered grading criteria will be some of the ways through which Learnz will be able to gradually transform itself into a fully autonomous, intelligent course-building ecosystem thus radically changing the whole know-how creation, delivery, and experience process in digital education.

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