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A Centralized Platform For Intelligent Educational Resource Creation

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Abstract: In recent years, Artificial Intelligence (AI) has made significant strides in transforming how educational materials are developed and delivered. This report introduces the AI HUB Platform, an innovative system designed to automate the creation of educational content. The platform can generate question-and-answer (Q&A) pairs, multiple-choice questions (MCQs), summaries, and even convert natural language into SQL queries for database searches. It leverages powerful AI technologies like Mistral 7B for natural language understanding, LangChain for structured query translation, and FastAPI for smooth deployment and integration. The research highlights how this platform reduces the need for manual work, enhances user interaction, and makes educational resources more accessible. Results show that the system significantly improves efficiency and user experience in educational content generation.

Introduction

Modern education increasingly requires interactive and personalized learning experiences to keep students engaged. However, creating learning materials such as Q&A sets, MCQs, study notes, and guides by hand is extremely time-consuming and demands significant human effort. This challenge becomes even greater when content needs to be produced at scale across multiple subjects, learning levels, and educational contexts.

Emerging technologies like Natural Language Processing (NLP) and Generative AI offer innovative solutions to automate these tasks. Yet many current AI systems struggle to deliver flexible, customized, and scalable content generation. They often produce static, generic materials that fail to meet the diverse and dynamic needs of students and educators.

To address these issues, the **AI HUB Platform** was developed. Unlike earlier solutions, this platform provides a flexible and adaptive framework for creating educational resources tailored to various learning scenarios. It combines several advanced AI tools to deliver dynamic, context-aware, and user-friendly content.

The core contributions of this project include:

1. Automatic generation of MCQs and Q&A content using the **Mistral 7B** language model, ensuring both linguistic precision and contextual relevance.
2. Transformation of natural language queries into SQL commands through **LangChain**, making it easier to interact with educational databases without needing technical SQL skills.
3. AI-driven explanations and analyses of images, diagrams, and charts, enhancing students' understanding of visual materials.
4. Seamless deployment using **FastAPI**, allowing the platform to integrate with Learning Management Systems (LMS) and other educational tools efficiently.

These innovations reduce the manual workload for teachers and content creators, improve the quality and reach of educational materials, and make learning resources more engaging and accessible for students worldwide.

Methodology

System Design

The AI HUB Platform is composed of several key components that work together to transform raw educational material into high-quality, structured content:

AI Model Backend: Handles critical operations such as generating Q&A pairs, MCQs, text summaries, and translating plain language into SQL queries.

FastAPI Server: Acts as an intermediary between the user and the AI models. It receives user requests, processes them through the AI backend, and returns structured results.

Frontend Dashboard: A user-friendly web interface where educators and users can upload documents, generate questions, and access processed content.

The entire system operates in multiple stages, starting from raw data input, through AI-driven processing, and finally delivering polished educational content ready for teaching and learning purposes.

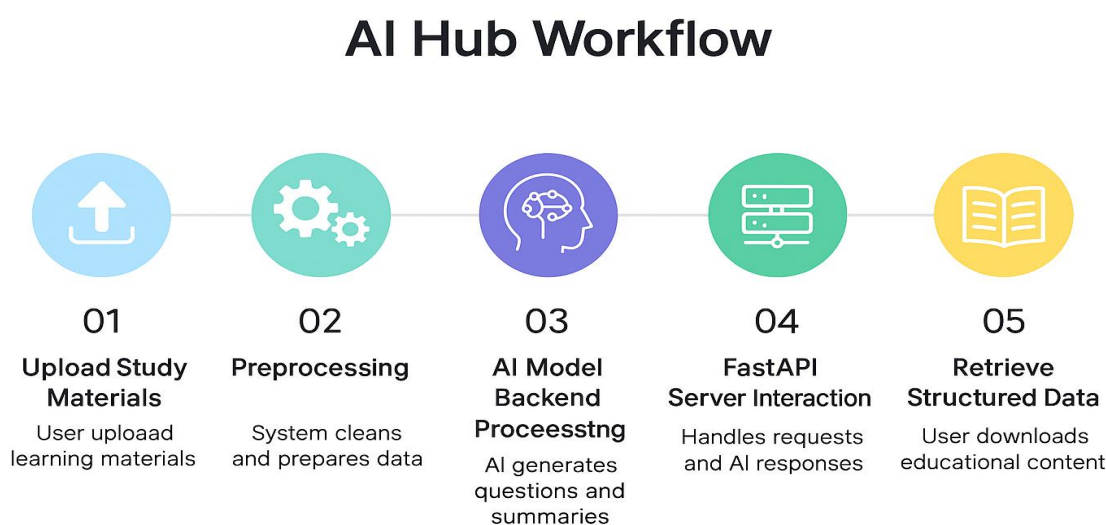


Fig 2.2.1:- System Architecture Diagram

Development Process

The platform was developed following a systematic, step-by-step approach to ensure accuracy and efficiency. The process included:

1. Data Collection and Preprocessing:

- 1.a. Educational data was gathered from diverse open-source repositories, including platforms like Kaggle and academic databases.
- 1.b. Data cleaning, tokenization, and normalization were performed to eliminate noise, irrelevant symbols, and inconsistent formatting. This ensured that the AI models received clear, structured input.
- 1.c. Techniques like **Named Entity Recognition (NER)** and **Keyword Extraction** were applied to identify important concepts and entities within the texts. This was crucial for generating meaningful questions and summaries.

1. Model Integration and Optimization:

- 1.a. The **Mistral 7B** model was fine-tuned using educational texts and research papers to enhance its ability to create contextually accurate MCQs and Q&A pairs.
- 1.b. **LangChain** was trained on datasets related to educational database queries to improve its capacity to translate natural language questions into SQL commands effectively.
- 1.c. The **Vision Transformer (ViT)** model was fine-tuned using annotated datasets to generate precise text descriptions of images, charts, and diagrams, making visual learning resources more accessible.

1. API Development and Deployment:

- 1.a. The backend services were built using **FastAPI**, ensuring high-speed processing and smooth communication between system components.
- 1.b. A scalable architecture was implemented to handle increasing demands without sacrificing performance.

1. Frontend Development:

- 1.a. The user interface was developed using **React.js** combined with **Tailwind CSS** for a modern, responsive, and easy-to-navigate experience.

1. Testing and Evaluation:

- 1.a. Comprehensive tests were conducted to measure the platform's accuracy, efficiency, and reliability.
- 1.b. Feedback was collected from users to identify potential improvements and refine the system further.

Development Phases of Educational Platform

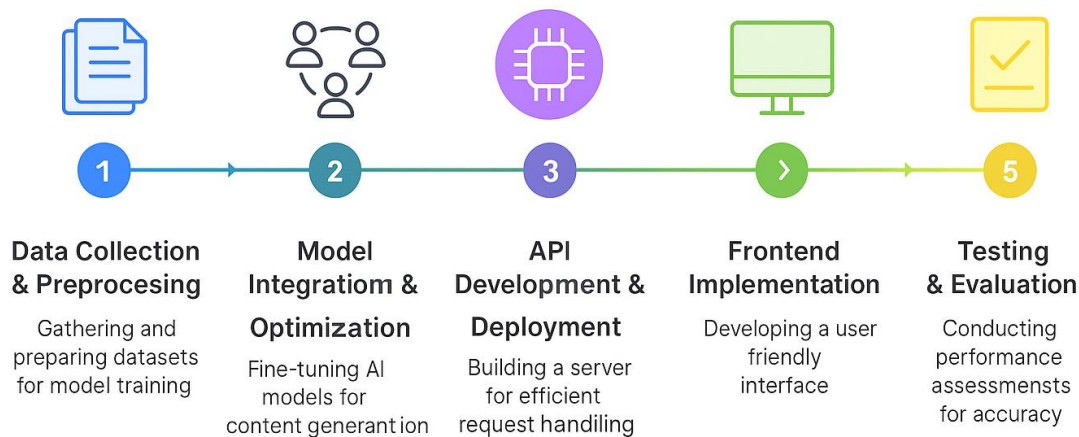


Fig 2.2.2: Step-by-Step Development Workflow for an AI-Powered Educational Platform

Tools and Technologies

Several advanced tools and technologies were chosen for their performance and scalability:

Natural Language Processing:

- o Mistral 7B for generating accurate and context-sensitive educational content.
- o LangChain for seamless text-to-SQL translations.
- o Vision Transformer (ViT) for interpreting and describing visual educational materials.

Backend:

- o FastAPI for developing high-performance APIs.
- o PostgreSQL for managing structured educational data.

Frontend:

- o React.js for building interactive user interfaces.
- o Tailwind CSS for modern and flexible design styling.

Results and Discussion

User Workflow

The AI HUB Platform follows a clear and logical workflow to deliver educational content:

Users start by uploading their study materials in digital formats such as PDFs, text documents, or scanned images.

The system uses NLP algorithms to analyze and process the uploaded content, identifying key topics and summarizing important information.

The processed data is then used to generate MCQs, quizzes, summaries, and other educational resources automatically.

Educators and students can access this newly generated content via an intuitive dashboard, where they can review, download, or share the materials.

A feedback mechanism allows users to provide insights about the generated content, helping the AI models improve over time.

STEPS IN THE WORKFLOW

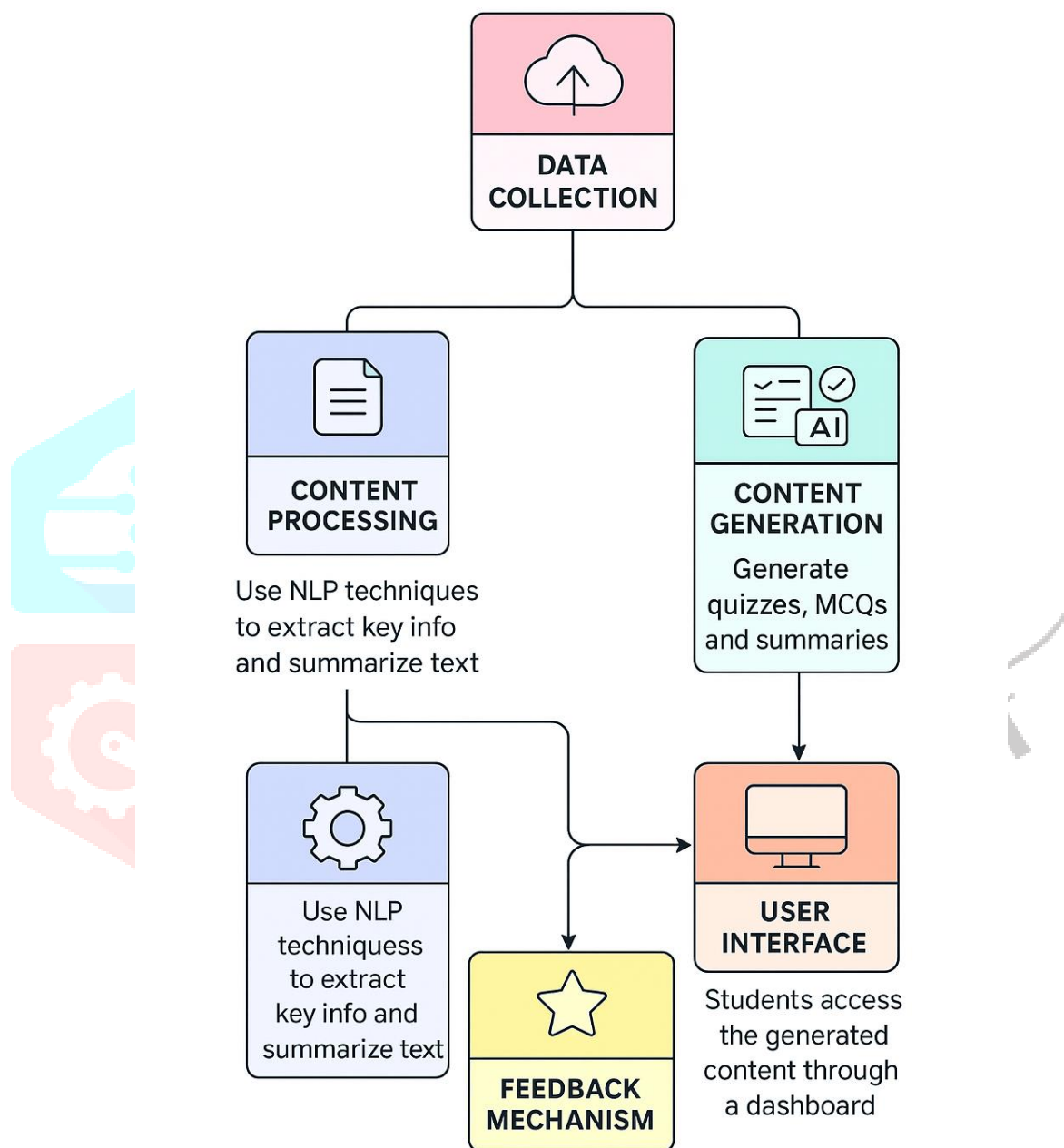


Fig 3.3.1:- AI-Powered Educational Content Workflow: From Data Collection to User Feedback

Homepage and Interface

The platform's homepage serves as a central hub for users to navigate various tools, including:

MCQ Generator

Q&A Creator

Code Generator

Text-to-Video Converter

The interface is designed to be visually appealing and user-friendly, ensuring that even users with minimal technical expertise can use the platform effectively.

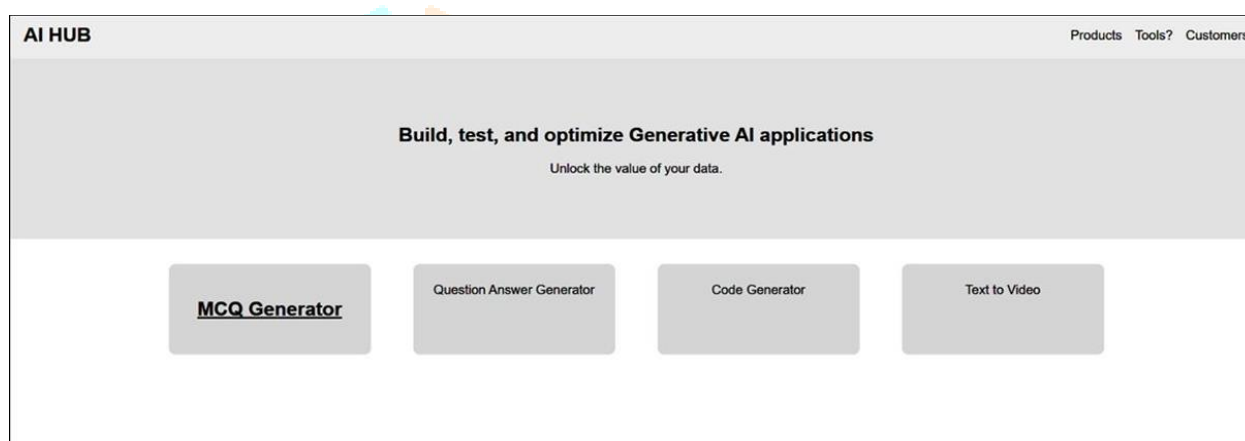


Fig 3.3.2.1:- HomePage Interface

Performance Analysis

The platform's performance was measured using both technical and user-focused metrics:

Accuracy of AI-Generated Content: Mistral 7B achieved an accuracy of 87.2% in generating Q&A pairs, while LangChain reached 90.5% accuracy in text-to-SQL translation.

Response Times: Mistral 7B generated answers in approximately 1.2 seconds, and LangChain performed translations in about 1.5 seconds. These fast response times ensure the platform's suitability for real-time applications.

User Feedback: Educators and students reported high satisfaction levels, noting the usefulness and relevance of the AI-generated materials.

These results confirm that the AI HUB Platform is robust, reliable, and effective in producing educational content at scale.

Challenges and Limitations

Despite its success, the platform faces some challenges:

The AI models sometimes struggle with complex or ambiguous queries, which can lead to less accurate results. Further fine-tuning and advanced disambiguation techniques are being explored to overcome this issue.

Ensuring fair and unbiased AI outputs is critical, as biases in training data could influence the quality and neutrality of the generated content.

As the demand for AI-driven educational tools increases, scaling the system to handle large volumes of requests without sacrificing performance remains a significant technical challenge.

Conclusion

The **AI HUB Platform** represents a major step forward in automating the creation of educational content. By leveraging state-of-the-art AI models like Mistral 7B, LangChain, and Vision Transformer, the platform significantly reduces manual work, improves efficiency, and enhances learning experiences for both teachers and students.

Looking ahead, several exciting developments are planned:

Incorporating **adaptive learning**, allowing the platform to adjust content difficulty based on individual student performance.

Supporting multiple languages to cater to diverse educational communities worldwide.

Integrating explainable AI (XAI) features to improve transparency and build trust in AI-generated materials.

Expanding collaboration tools and deeper LMS integration to promote interactive and collaborative learning environments.

The AI HUB Platform holds great promise as an essential tool in the future of digital education, enabling the creation of customized, engaging, and accessible learning resources at an unprecedented scale.