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Department of Computer Science and Engineering (AI & ML)

PROJECT ABSTRACT – [ADMITTED BATCH: 2022-2026]

YEAR & BRANCH: IV B. TECH. – COMPUTER SCIENCE AND ENGINEERING (AI&ML)	**BATCH NO. : 06**	**SECTION: 2**

BATCH DETAILS:

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PROJECT GUIDE NAME:	**PROJECT TITLE:**
Dr K. Purushotam Naidu	**Generative AI Agent for Automated Study Guide Creation**

ABSTRACT:

The preparation of instructional materials such as topic summaries, question banks, structured lesson plans, and reference notes requires significant manual effort from academic instructors. To reduce this workload, an automated system is developed that processes educational documents and generates structured teaching resources using generative AI techniques. The system accepts inputs in the form of pdfs, text files, and lecture notes. The content is extracted, cleaned, segmented, and converted into dense vector embeddings using sentence-transformer models, which are stored in a chrome vector database to enable efficient semantic retrieval. A locally hosted large language model (LLM), executed through ollama and orchestrated using Lang chain, is utilized to produce multiple academic outputs. These include topic-wise summaries accompanied by keyword extraction, question–answer pairs derived from input materials, and flashcards formatted for quick revision. In addition to these core functionalities, the system incorporates advanced analytical modules. The lecture planner component automatically generates structured lesson plans containing learning objectives, key concepts, and a module-wise breakdown. The content gap detector identifies missing explanations, insufficient detail, or underdeveloped concepts within the uploaded material. The document comparison module performs a differential analysis between two document versions to detect additions, deletions, and modifications. An optional assignment generator produces assignment questions and practice tasks based on the processed content. The complete workflow is implemented through a streamlit interface that supports document upload, operation selection, and output visualization. The system demonstrates the application of retrieval-augmented generation and local LLM processing for automating academic content generation, with the objective of reducing manual instructional preparation and producing consistent, structured, and analyzable teaching materials.

DOMAINS WHERE THE PROJECT CAN BE IMPLEMENTED:

- **Higher Education Institutions** – automate summaries, lesson plans, and academic content creation.
- **Schools & K–12 Education** – generate structured teaching materials and revision resources.
- **EdTech Platforms** – power personalized learning, RAG-based study guides, and adaptive assessments.
- **Corporate Training & Skill Development** – create automated training modules and evaluation content.
- **Coaching & Competitive Exam Centers** – produce question banks, mock tests, and concise topic notes.

IMPLEMENTATION:

The system is implemented through a multi-stage workflow involving document processing, embedding generation, retrieval, and output synthesis. Uploaded educational materials are first extracted and cleaned to produce raw textual content. This content is segmented into smaller, semantically meaningful units and converted into dense embeddings using sentence-transformer models. These embeddings are stored in a Chroma DB vector database for efficient retrieval. A local Large Language Model (LLM), executed via Ollama and controlled through Lang Chain, performs generative and analytical tasks. Retrieval-Augmented Generation (RAG) mechanisms fetch relevant content segments from the vector database and supply them to the LLM for the production of summaries with keywords, question–answer pairs, flashcards, lecture plans, assignment items, and analytical insights. Additional modules process the same content to detect conceptual gaps and perform document comparison. All system functionalities are accessed through a Streamlit interface that enables document upload, tool selection, and output visualization.

PRINCIPLE IDEA:

The principal idea of the system is to automate the generation and evaluation of instructional material using Generative AI combined with retrieval-based text processing. Academic content preparation traditionally requires significant manual involvement, including summarizing topics, preparing questions, designing lesson plans, and analyzing document revisions. By leveraging embeddings, vector search, and local language models, the system transforms raw educational documents into structured pedagogical outputs. The integration of analytical components such as content gap detection and document comparison extends the functionality beyond text generation to include evaluation and quality assessment. The underlying concept is to employ AI-driven text understanding to support instructors in creating consistent, comprehensive, and well-structured academic resources.

VISION:

The long-term vision of the system is to establish a unified AI-driven framework capable of automating a wide range of academic content creation and analysis tasks. The objective is to support instructors by minimizing routine manual preparation and enabling data-driven insights into the completeness and structure of instructional material. The system is designed to enhance the accuracy, consistency, and organization of teaching resources while operating as a reliable academic assistant. The broader goal is to integrate AI-powered document processing into educational workflows, enabling scalable and efficient production of learning materials across institutions and subject domains.

BASE REFERENCE PAPER DETAILS:
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Name & Signature of Project Guide