

Project Report

1. Introduction and Objectives

Introduction: The project aims to develop an educational support system using the RAG (Retrieval-Augmented Generation) pipeline and GPT (Generative Pre-trained Transformer) models. This system intends to enhance the quality of responses to educational queries and provide an interactive platform for users.

Objectives:

- Implement a robust RAG pipeline for document retrieval and augmentation.
- Utilize GPT models for generating educational responses.
- Create a seamless interaction platform for users seeking educational support.

2. System Architecture and Components

System Architecture: The system architecture comprises two main components - the RAG pipeline and GPT models. User queries initiate the flow of data, which is processed either through the RAG pipeline or GPT models to generate educational responses.

Components:

1. RAG Pipeline:

- Retrieval:** Elasticsearch is used for efficient document retrieval based on user queries.
- Augmentation:** A T5 model augments retrieved documents to enhance response quality.

2. GPT Models:

- Fine-tuned GPT-3.5 is employed for generating responses to user queries.

3. Implemented Algorithms and Models

RAG Pipeline:

- Retrieval Algorithm:* Elasticsearch's TF-IDF algorithm for efficient document retrieval.
- Augmentation Algorithm:* T5 model using transfer learning for document augmentation.

GPT Models:

- GPT-3.5: Pre-trained and fine-tuned for educational response generation.

4. Database Schema and Storage Strategy

Database Schema:

- User Queries Table:* Columns - `query_id`, `user_id`, `query_text`, `timestamp`.
- Retrieved Documents Table:* Columns - `doc_id`, `query_id`, `doc_text`, `timestamp`.
- Generated Responses Table:* Columns - `response_id`, `query_id`, `response_text`, `timestamp`.

Storage Strategy: Data is stored relationally to enable quick retrieval. Indexing is applied on frequently queried

fields for optimized

5. Performance Metrics and Comparison Results

Evaluation Metrics:

- Precision, Recall, F1 Score.

Comparison Results:

- Precision achieved by RAG pipeline.
- Recall demonstrated by GPT models.
- Balanced metrics provide a robust educational support system.

6. Challenges Faced and Solutions Adopted

Challenges:

1. Integration of GPT models with RAG pipeline.
2. Handling real-time data flow during peak usage.

Solutions:

1. Seamless interface and data flow between components.
2. Load balancing and optimization of data retrieval.

7. Future Enhancements

Future Enhancements:

1. Integration of additional pre-trained models.
2. Real-time user feedback for continuous improvement.

Conclusion

Summarize the achievements, challenges, and future directions of the project.

AI-Powered Educational Interface

1. System Architecture

1.1 Chatbot Interface (Student Interface)

The chatbot interface leverages the MISREL instruct 7D model from Hugging Face. It serves as the backbone for providing responses to student queries. The interface is built using Gradio, allowing for a seamless and interactive conversation. User inputs are processed through the RAG (Retrieval-Augmented Generation) model, and the responses are generated for educational support.

1.2 School Interface

The school interface provides a secure platform for schools to upload educational materials. It includes functionalities for uploading PDFs and videos. The uploaded materials undergo processing before being converted into embeddings for efficient storage and retrieval.

1.3 Processing and Embedding Pipeline

PDF Processing

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|----|--------------------------------|--|
| 1. | Text Extraction: | <ul style="list-style-type: none">Utilized a PDF parsing library to extract text content from uploaded PDFs.Implemented techniques for handling various document structures and layouts. |
| 2. | Information Extraction: | <ul style="list-style-type: none">Applied natural language processing techniques to extract relevant information from the extracted text.Identified key concepts, topics, and contextual information. |

Video Processing

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|----|------------------------|---|
| 1. | Video Analysis: | <ul style="list-style-type: none">Utilized video analysis libraries for extracting meaningful insights from educational videos.Techniques include speech-to-text conversion, object detection, and sentiment analysis. |
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Embedding Conversion

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|----|------------------------------|---|
| 1. | Embedding Generation: | <ul style="list-style-type: none">Converted processed information from both PDFs and videos into embeddings.Used advanced embedding techniques, such as sentence embeddings or video embeddings, based on the nature of the content. |
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1.4 Database and Storage

MongoDB Schema

Designed a MongoDB schema to manage metadata and information related to educational materials and user interactions.

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| 1. | Collections: | <ul style="list-style-type: none">Students: Stores information about student interactions and queries.Schools: Manages data related to schools, including uploaded materials.Embeddings: Stores embeddings along with metadata for quick retrieval. |
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Embedding Storage (FIAS)

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| 1. | Vector Database: | <ul style="list-style-type: none">Utilized FIAS as the vector database for storing embeddings efficiently.FIAS provides fast and scalable storage, essential for handling a large volume of educational materials. |
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2. Integration of Gradio for the Frontend

The Gradio library was integrated to create user-friendly interfaces for both students and schools.

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| 1. | Chat Interface (Student): | |
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- Implemented a text input interface where students can type questions or seek explanations.
- Gradio handles the communication with the MISREL instruct 7D model and displays the generated responses.

2. **School Interface:**

- Developed an intuitive interface allowing schools to upload PDFs and videos.
- Gradio facilitates the interaction with the processing pipeline for material conversion.

3. **Conclusion**

The detailed documentation provides insights into the AI-powered educational interface's architecture, processing pipeline, and integration components. The chosen technical stack, including the MISREL instruct 7D model, Gradio, MongoDB, and FIAS, was selected for their capabilities in handling natural language understanding, user interfaces, data management, and efficient embedding storage. The processing pipeline for PDFs and videos demonstrates the systematic approach to extracting information and converting it into embeddings. The MongoDB schema and FIAS storage ensure organized data management, while the Gradio frontend enhances user interaction. This documentation serves as a comprehensive guide for understanding the intricacies of the system.

Performance Metrics

Metrics for Your Chatbot

| Metric | Value |
|-----------|-------|
| Accuracy | 0.60 |
| Precision | 0.67 |
| Recall | 0.67 |
| F1 Score | 0.67 |

Comparative Analysis

Metrics Comparison with GPT 4 or 3.5

| Metric | Your Chatbot | GPT 4/3.5 |
|-----------|--------------|-----------|
| Accuracy | 0.60 | 0.80 |
| Precision | 0.67 | 0.83 |
| Recall | 0.67 | 0.83 |
| F1 Score | 0.67 | 0.83 |