SmarterLearn: Intelligent Learning Tools for Personalized Education
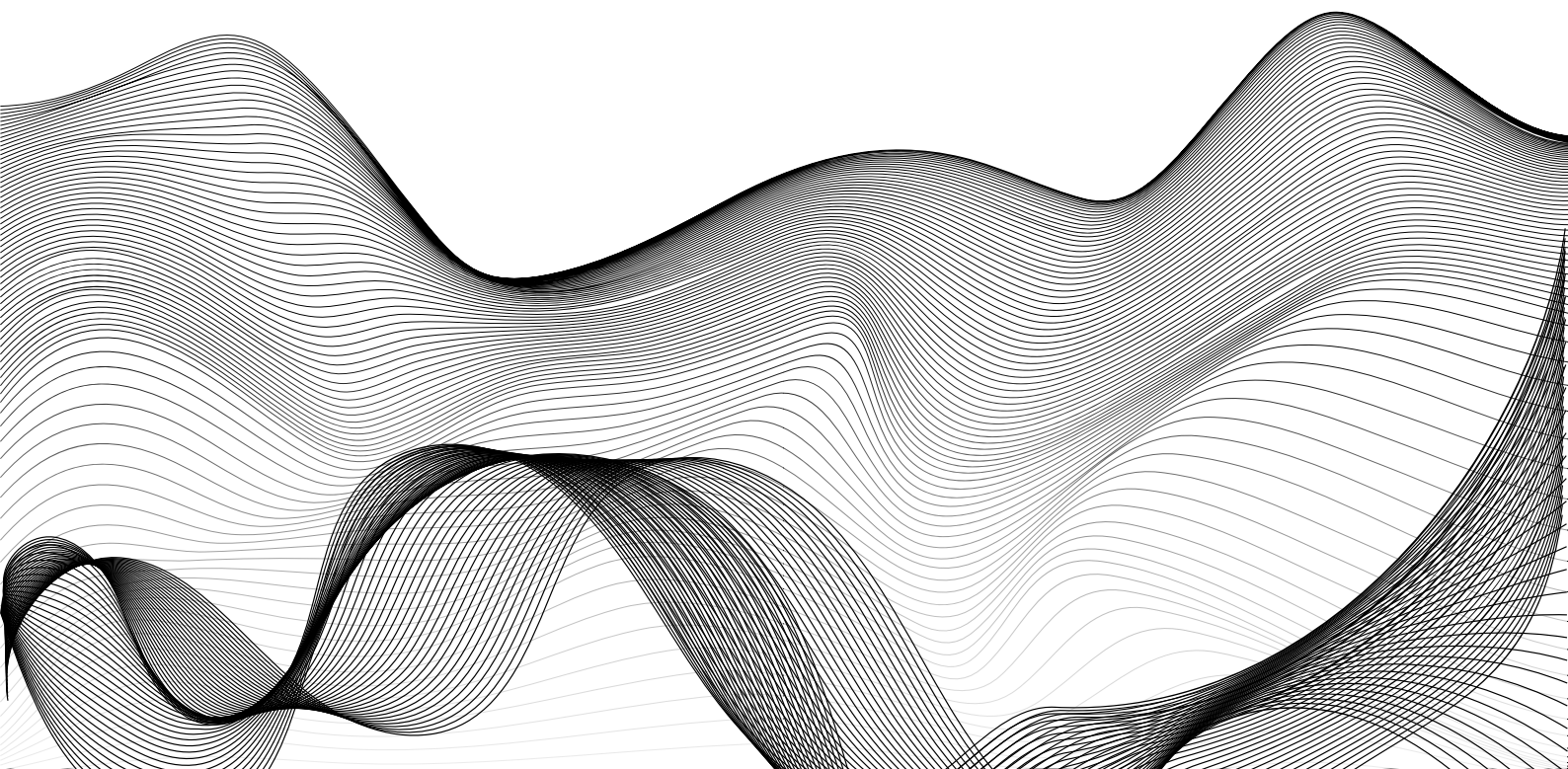
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P R O J E C T - 2 0 2 5

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1.1 Objective

The objective of this project is to create an AI-powered platform that tailors educational content to various learning styles. By leveraging AI tools, the platform will transform content (such as YouTube videos) into multiple formats (mind maps, quizzes, and interactive chat) to suit different types of learners: visual learners, auditory learners, reading/writing learners, and kinesthetic learners. Each learner type will have a customized experience to help them absorb and retain the educational material more effectively.

1.2 Description

This project aims to optimize the learning experience for diverse learners by providing different tools that cater to each individual's preferred learning style. The platform will extract transcripts from YouTube videos, clean and summarize the content, and then generate specific learning tools tailored to:

- Visual Learners: Mind maps and diagrams to represent content visually.
- Auditory Learners: Interactive, conversational AI chat to explain and discuss the content.
- Reading/Writing Learners: Interactive Q&A system for asking questions about the video content.
- Kinesthetic Learners: Quizzes and interactive activities to reinforce learning through hands-on engagement.

This tools will make educational content more accessible, engaging, and personalized for different learning preferences.
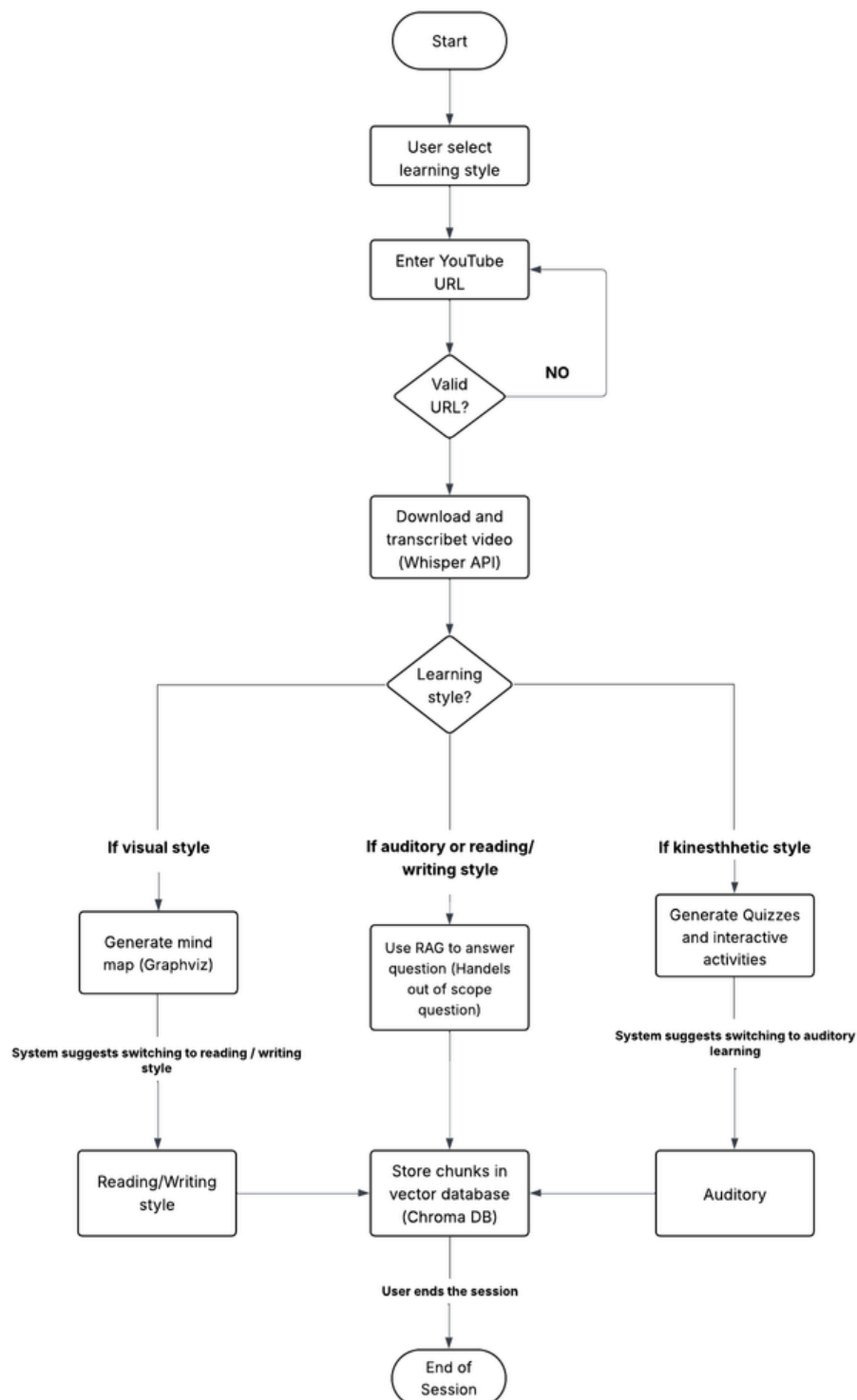
1.3 Project Architecture

The system is built using:

- Speech-to-Text (Whisper API) → Converts YouTube videos to text.
- Text Processing → Cleans and organizes transcripts.
- Multi-Modal Learning Tools → Tailored outputs for each learner type: mind maps (visual), quizzes (kinesthetic), Interactive Q&A system (reading), and interactive voice chat (auditory).
- Retrieval-Augmented Generation (RAG) → Specifically supports the reading and auditory learning modes by enabling precise, context-aware Q&A based on the stored transcript.
- Agent System → Orchestrates different tools and manages interaction modes.

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1.4 SmarterLearn Architecture Flowchart

While section 1.3 provides a detailed written description of the system components, the following flowchart in section 1.4 complements it by offering a visual summary of the architecture and workflows.

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                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         │
                  ┌──────▼──────┐
                  │ User select │
                  │learning style│
                  └──────┬──────┘
                         │
                  ┌──────▼──────┐◄─────────┐
                  │Enter YouTube│          │
                  │    URL      │          │
                  └──────┬──────┘          │
                         │                 │
                    ◇─────────◇   NO        │
                    │  Valid  │─────────────┘
                    │  URL?   │
                    ◇────┬────◇
                         │
                  ┌──────▼──────┐
                  │ Download and│
                  │transcribet  │
                  │video        │
                  │(Whisper API)│
                  └──────┬──────┘
                         │
                    ◇─────────◇
                    │Learning │
                    │ style?  │
                    ◇─────────◇
```

If visual style — Generate mind map (Graphviz) — System suggests switching to reading / writing style — Reading/Writing style

If auditory or reading/writing style — Use RAG to answer question (Handels out of scope question) — Store chunks in vector database (Chroma DB)

If kinesthhetic style — Generate Quizzes and interactive activities — System suggests switching to auditory learning — Auditory

User ends the session — End of Session

1.5 Methodology

The development followed these steps:

1. Download and transcribe YouTube videos.

2. Clean and preprocess transcripts.

3. Create knowledge chunks for RAG-based retrieval.

4. Build a multi-tool AI agent that switches modes based on user selection.

5. Integrate mind map generation, chatbot interaction, Interactive Q&A , and quizzes.

6. Test the platform across different learning styles to ensure smooth switching and relevant outputs.

1.6 Setup Instructions

To run the project locally:
1. Clone the repository
2. Activate the virtual environment
3. Install dependencies
4. Configure API keys (OpenAI, Whisper, HuggingFace) inside the env file.
5. Run the main script

1.7 System Testing & Updates

In addition to the core implementation, the system has been thoroughly tested through various real-world scenarios to ensure robustness and user-centered behavior.

Key test cases verified :

- **Memory Recall :**

When asked, the system successfully remembers and retrieves the user's previous question, demonstrating working short-term memory.

- **Auditory Mode Guardrails :**

In auditory learning mode, the system correctly refuses to answer questions unrelated to the video transcript, ensuring focused and relevant conversations.

- **Reading Mode Guardrails :**

Similarly, in reading (Q&A) mode, the system blocks unrelated questions and keeps responses strictly tied to the video content.

- **URL Validation :**

If the user provides an invalid or incomplete YouTube URL, the system detects it, raises an error message, and prompts the user to enter a valid YouTube link.

- **Session Completion & Smart Suggestions :**

After finishing one learning path, the system confirms session completion and intelligently suggests a different learning style. If the user tries to pick the same style again, the system prompts them to choose a new, untested style.

1.8 Results & Achievements

- Developed a functioning multi-style learning platform.
- Successfully integrated Whisper, LangChain, Chroma, and OpenAI tools.
- Demonstrated adaptability for various learners using live YouTube content.
- Created engaging outputs (mind maps, quizzes, conversations) in real-time.

1.9 Future Improvements

- Add user personalization based on learning history.
- Integrate more languages beyond English.
- Expand to non-video content (like PDFs, articles).
- Improve mind map generation by using LLM-based direct diagram generation or future libraries once such technologies become available, as they are currently not yet accessible.