**WATCHAI – Tech Stack Document**

**Project Name:** WATCHAI  
**Document Type:** Technology Stack Overview  
**Author:** Ishaan Goyal

**1. Frontend**

* **Framework:** Next.js with React
* **Language:** TypeScript
* **Styling:** Tailwind CSS v3.4
* **Routing Structure:** App router using file-based routing under /app
* **Authentication UI:** Integrated with Firebase Authentication (supports Email/Password, Google login)

**2. Backend / API**

* **API Layer:**
  + Custom API routes within Next.js (e.g., /app/api)
  + REST-style endpoints to trigger embedding pipeline or serve recommendations
* **Authentication & Authorization:**
  + Firebase Authentication SDK (client-side)
  + Firebase Admin SDK (server-side, for protected Firestore access)
* **Recommendation Engine:**
  + Hybrid setup:
    - **Client-side**: Lightweight, fast suggestions based on recent history
    - **Server-triggered**: Deep similarity search based on multimodal embeddings

**3. Database & Storage**

* **Database:**
  + Firebase Firestore
  + Structure: One document per video, storing metadata, embeddings, and status
* **Storage:**
  + Firebase Storage
  + Used for storing raw videos, thumbnails, and extracted features if needed
* **Indexing:**
  + Firestore indexes for userId, videoId, tags, categories

**4. AI / ML Models**

**Multimodal Extraction**

* **Transcription:**
  + OpenAI Whisper (or WhisperX for faster and accurate results)
* **Summarization:**
  + Transformer-based models (e.g., T5-small, BART via Hugging Face)
* **Visual Embeddings:**
  + CLIP (Contrastive Language–Image Pretraining by OpenAI)
  + ViT (Vision Transformer) for fine-tuned frame embeddings
* **Audio Embeddings:**
  + Extracted using librosa (MFCCs, chroma features, mel spectrograms)
* **Text Embeddings:**
  + SentenceTransformers (e.g., all-MiniLM-L6-v2, paraphrase-MiniLM)

**Similarity Search**

* **Engine:** FAISS (Facebook AI Similarity Search)
* **Method:** Cosine similarity on concatenated multimodal vectors

**5. DevOps & Deployment**

* **Version Control:**
  + Git with GitHub
* **Monitoring & Logs:**
  + Firebase Console (built-in monitoring)