1. Project Overview

1.1 What is the Project?

Rewind is a Video Memory System that processes 24-hour video recordings to create a searchable memory database. It enables natural language queries to find objects, events, and conversations from past recordings. The system combines computer vision, audio transcription, and multimodal AI to create a searchable archive of daily life.

Core Concept: Like a personal assistant that remembers everything you see and hear, allowing you to ask questions like "Where did I last see my water bottle?" or "When was my CS366 exam mentioned?"

1.2 Key Features

- Multimodal Processing: Processes both video frames and audio transcripts
- Object Detection: Identifies objects (cup, phone, person, laptop, keys) using YOLOv8
- Audio Transcription: Transcribes speech using Whisper with word-level timestamps
- Semantic Search: Uses CLIP embeddings for natural language queries
- Conversational AI: Generates natural language responses about memories
- Time Tracking: Maps video timestamps to actual calendar dates/times
- Dual Query Types: Supports both object queries (with images) and memory/event queries (text-only)

2. What Has Been Completed

2.1 Core Infrastructure (V1)

Video Processing Pipeline:
- Frame extraction at configurable intervals (default: 0.75s)
- YOLOv8 object detection on each frame
- CLIP embedding generation for visual search
- FAISS vector store for efficient similarity search
- Metadata storage with timestamps and object detections

Query System:
- Text-based semantic search using CLIP embeddings
- Image-based search capability
- Basic response generation

2.2 Enhanced System (V2) - Still needs to be tested

24-Hour Video Chunk Processing:
- Frame extraction at 5-10 fps (configurable, default: 7.5 fps)
- Handles full 24-hour video recordings from Raspberry Pi
- Date/time tracking with absolute datetime mapping
- Video metadata management with period tracking

Audio Transcription Integration:
- FFmpeg audio extraction from video files
- Whisper transcription with word-level timestamps
- Separate vector store for audio transcripts
- Time synchronization between video and audio

Advanced Query System:
- Dual-mode search: video frames and audio transcripts
- Query classification: automatically detects object vs. memory queries
- Conversational AI responses using open-source LLMs (HuggingFace)
- Frame extraction for object queries (saves actual frame images)
- Smart template fallback when LLM APIs are unavailable

Query Types Implemented
- Object Queries: "Where is my water bottle?" → Returns frame image + conversational response
- Memory Queries: "When was CS366 midterm mentioned?" → Returns text-only response with formatted dates

3. Current Work

3.1 What I'm Working on Right Now

System Refinement:
- Optimizing frame extraction rates for 24-hour videos (balancing accuracy vs. processing time)
- Improving query classification accuracy
- Enhancing conversational responses with better context understanding
- Testing with real-world video data

Performance Optimization:
- Reducing processing time for 24-hour videos
- Optimizing vector store search performance

- Improving memory usage for large video datasets

User Experience:
- Refining conversational responses to be more natural
- Improving error handling and edge cases
- Adding better logging and progress indicators

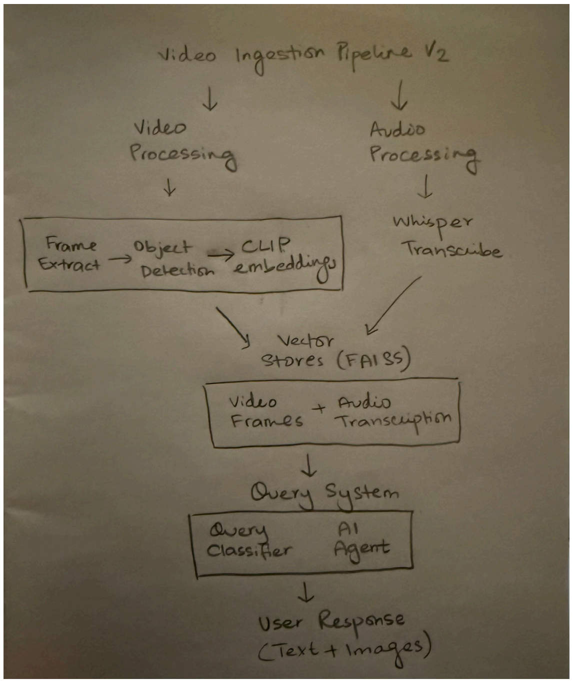
4. Plan Before Final Demo

1. Demo Preparation
   - Create sample video dataset with diverse scenarios
   - Prepare example queries showcasing both object and memory queries
   - Generate output examples (frame images, responses)
   - Create visualizations of system architecture

2. UI/Interface Improvements
   - Build simple command-line interface for demo

3. Query Response Quality
   - Fine-tune conversational responses
   - Improve date/time formatting
   - Add more context to responses

5. System Architecture



6. Other Details

6.1 Technologies Used

Computer Vision:

- YOLOv8 (Ultralytics): Real-time object detection
- CLIP (OpenAI): Multimodal embeddings for images and text

Audio Processing:

- Whisper (OpenAI): Speech-to-text transcription
- FFmpeg: Audio extraction from video

Vector Search:

- FAISS (Facebook AI Similarity Search): Efficient similarity search
- 512-dimensional embeddings (CLIP base model)

AI/LLM:

- HuggingFace Inference API: Open-source LLM access
- Template-based fallback: Smart responses without API

6.2 Audience Engagement Plan

1. Live Demo - Object Query
   - Query: "Where is my water bottle?"
   - Show: Real-time search → Frame extraction → Conversational response
   - Highlight: Natural language understanding

2. Live Demo - Memory Query
   - Query: "When was my CS366 exam mentioned?"
   - Show: Audio search → Date extraction → Formatted response
   - Highlight: Multimodal search capability

3. Technical Deep Dive
   - Show system architecture diagram
   - Explain: YOLOv8 detection, CLIP embeddings, Whisper transcription
   - Show: Vector store statistics, processing pipeline

5. Interactive Demo
   - Allow audience to suggest queries
   - Show real-time processing

7. References

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2. Radford, A., et al. (2021). "Learning Transferable Visual Models From Natural Language Supervision." ICML 2021.

3. Radford, A., et al. (2022). "Robust Speech Recognition via Large-Scale Weak Supervision." arXiv:2212.04356.

4. Johnson, J., et al. (2019). "Billion-scale similarity search with GPUs." arXiv:1702.08734.