RAG AI Agent for continued exercise therapy conformance

Perception based AI coaching agent

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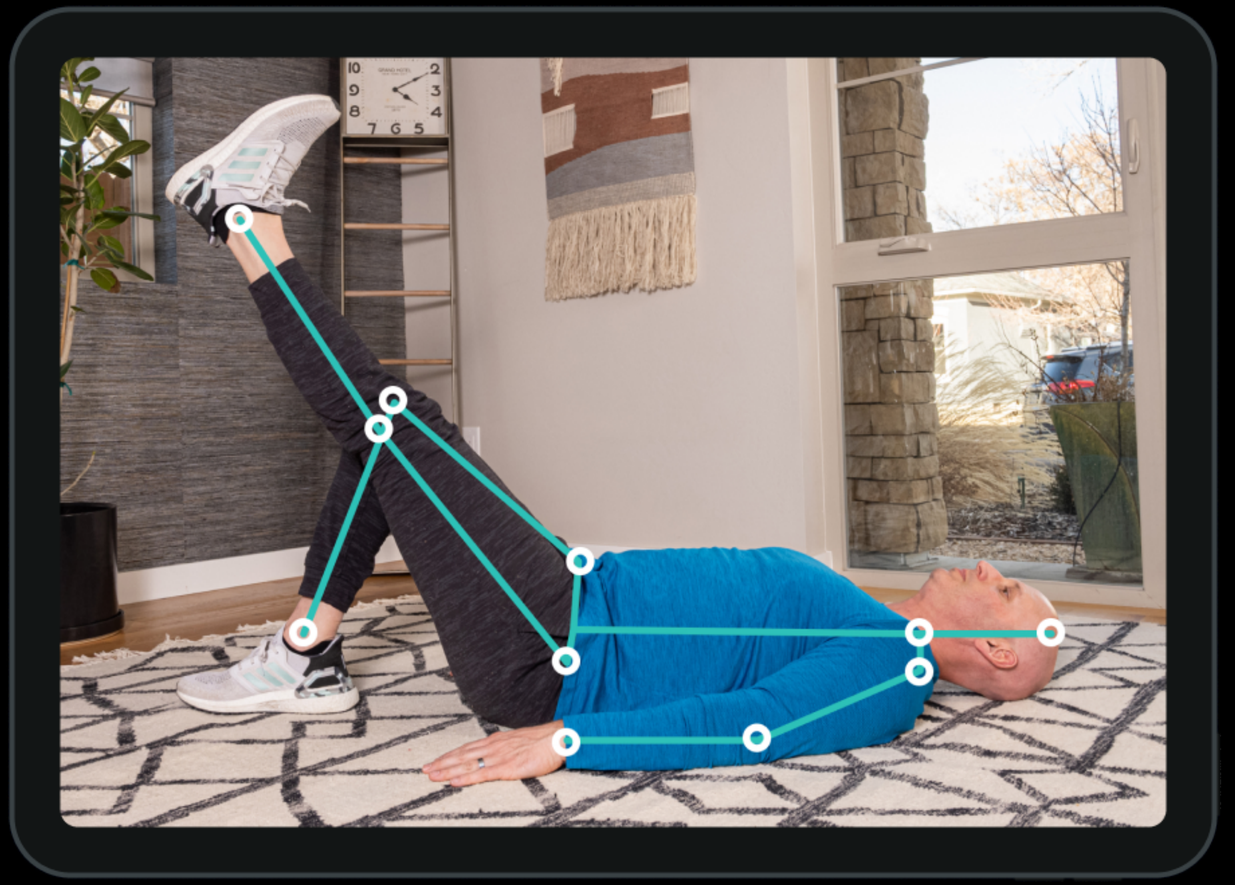
Our Idea

- Patients are typically prescribed exercise they may not know how to complete at home
  - They may not adhere to the exercise therapy or improperly perform the movements
- Our AI agent will be tuned to specific patient needs
  - Assess patient performance on exercise and provide feedback
- Two modules:
  - Video analysis of exercise
  - RAG based AI agent personalized to patient



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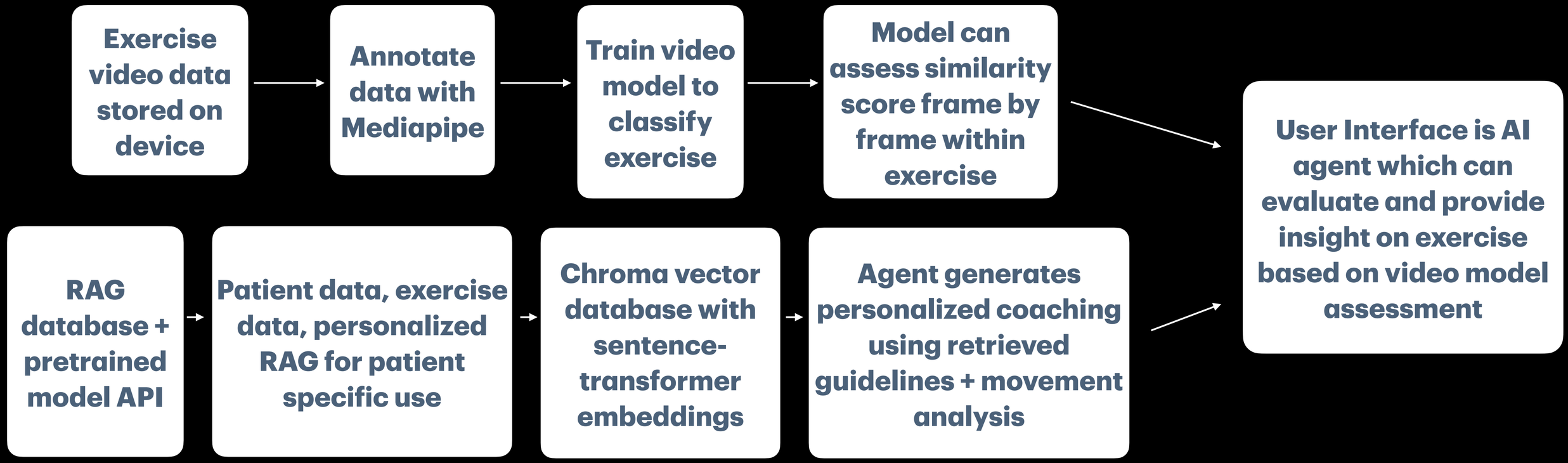
Team Objectives and Individual Roles

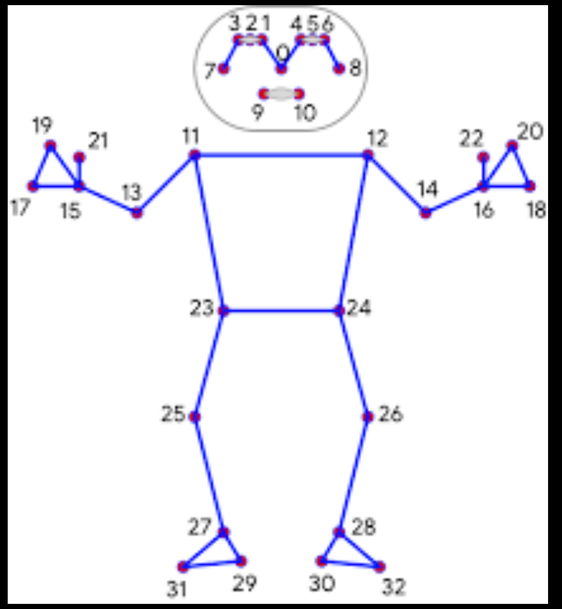
- **Minimum Viable Product**
  - RAG Agent + functional CV pipeline
  - Dream: Polished patient-facing mobile app coaching through full rehabilitation process
- **Individual Roles - what we've worked on so far**
- **Datasets:**
  - RAG Agent - PT Guidelines from various certified sources (e.g. Physiopedia, MSK)
  - CV pipeline - pre-trained model possibly fine-tuned with KIMORE/ rehabilitation dataset

Prototype System Design



Example Related Works

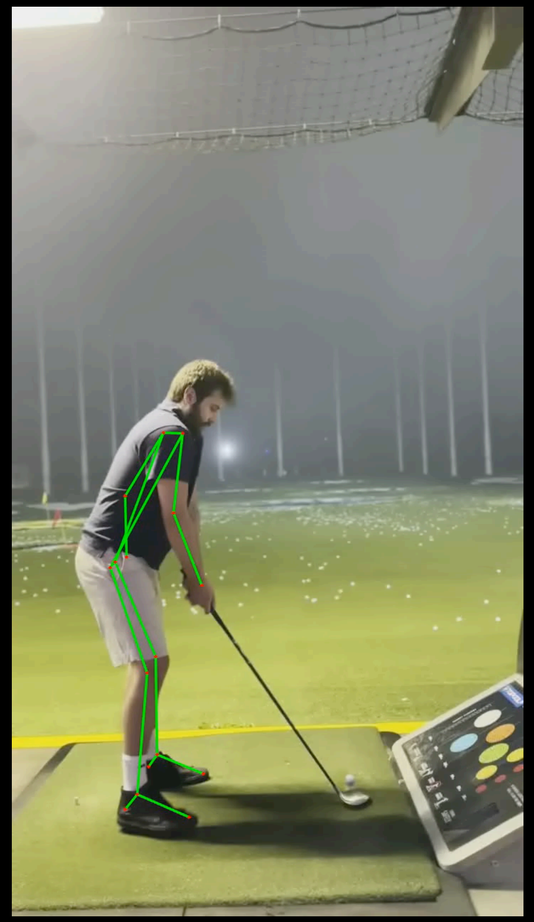
- Foundational: **OpenPose** (Carnegie Mellon): The first real-time multi-person system to jointly detect human body, hand, facial, and foot keypoints (135 total keypoints) from single RGB images.
- Uses Part Affinity Fields, 2D vector fields that encode the location and orientation of limbs
- Matching body parts with specific individuals in multi-person scenes
- Uses bottom-up approach, detecting all keypoints then grouping them to individual people, with constant runtime regardless of number of people in image
- **BlazePose** (Google): Small and Efficient especially for Mobile. Produces 33 body keypoints encompassing body, face, and hand landmarks and runs at over 30 frames per second.
- Two-step detector-tracker pipeline: Detector locates the pose region-of-interest, then a tracker predicts all keypoints within that region.
- **RAG in Medicine** (Xiong et al., 2025): Systematic evaluation showed evidence filtering and query reformulation improved medical QA by 12%. Text-rich guidelines outperform diagram-heavy protocols - informs our PT guideline selection and chunking strategy.



Source: https://www.google.com/url?sa=t&source=web&rct=j&url=https://ar5iv.labs.arxiv.org/html/2006.10204&ved=0CBYQjRxqGAoTCNiu_c7_vZIDFQAAAAAdAAAAABDAAQ&opi=89978449

Current progress

CV



Traditional RAG

- 100% retrieval accuracy across 6 PT guideline categories (contraindications, exercise form, exercise selection, pain management, progression, timeline)
  - **Key optimizations**: BeautifulSoup HTML parsing, 1000-char chunks with 200-char overlap, retrieval reranking (top-10 → best-3)
- 80% Answer Completeness
- Fast response time (~6.5s total) and token efficient
- Successfully tested on complex multi-part queries requiring exercise progression and form guidance

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Query: What exercises should I do for shoulder impingement?

Total time: 6.27s
  - Retrieval: 13ms
  - Generation: 6.26s

Tokens: 856 in, 314 out

Answer:
Based on the provided PT guidelines, here are three recommended exercises for shoulder impingement (subacromial pain syndrome

## 1. Isometric Shoulder Internal and External Rotation
- Place a rolled-up towel under the affected arm
- Stand at a wall corner with elbow bent at 90 degrees
- **Internal rotation:** Push flat hand into wall at 25-50% pressure, hold 10 seconds, repeat 10 times
- **External rotation:** Turn body and push outside of hand into wall at 25-50% pressure, hold 10 seconds, repeat 10 times
- This strengthens rotator cuff muscles and increases shoulder weight-bearing capacity

## 2. Side-Lying Shoulder External Rotation
- Use the same rolled-up towel under your arm
- Lie on non-injured side with head on pillow
- Top arm bent at 90 degrees in front of you
- Lift light weight (start with 1-pound water bottle) straight up until in line with shoulder
- Lower slowly back down

The guidelines note that you may feel a mild burn on the outside of the shoulder during these exercises, and you can graduall

**Source:** Exercises for Shoulder Impingement, from a PT.html

*Note: The context mentions three exercises but only provides complete details for two of them.*
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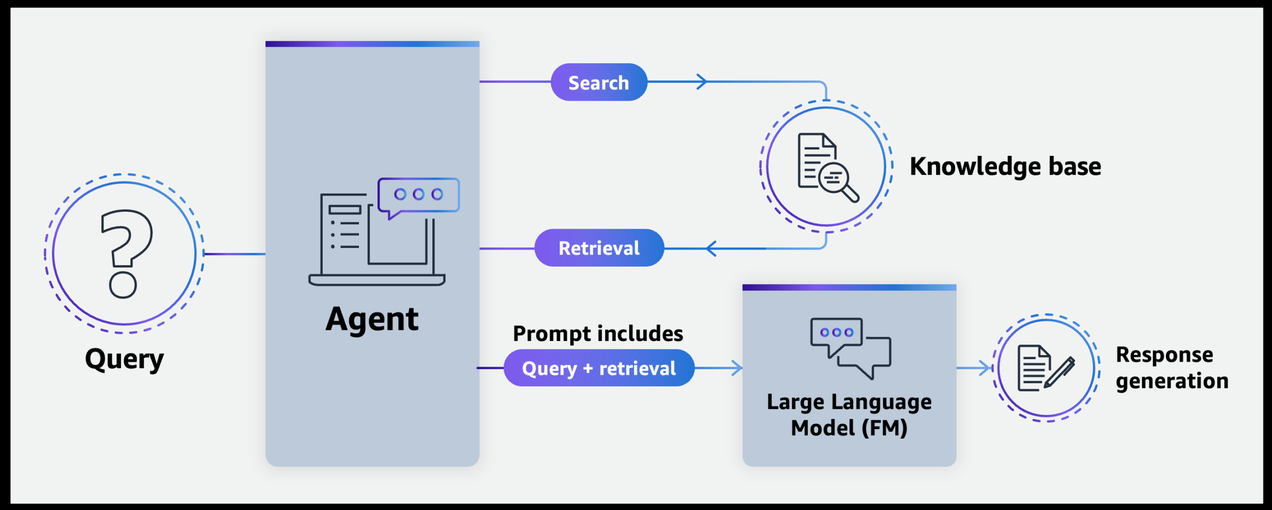
Next Steps

Investigate EFKA - Free Knowledge Agent



- No Embeddings: Direct file system access, no vector database needed
- Agent-First: Let the AI agent intelligently search and combine information
- Transparent: You can read the same files the agent reads
- Reliable: No semantic drift or embedding quality issues
- Latency: Response times are longer than traditional RAG, typically in the 10-30 second range
- Token Consumption: The agent-based approach consumes more tokens

Source: https://www.google.com/url?sa=t&source=web&rct=j&url=https://aws.amazon.com/blogs/aws/preview-connect-foundation-models-to-your-company-data-sources-with-agents-for-amazon-bedrock/&ved=0CBYQjRxqFwoTCNjjiqCCvpIDFQAAAAAdAAAAABAi&opi=89978449