



# Virtual Yoga Coach

Areas: Software Systems and Signals & Systems

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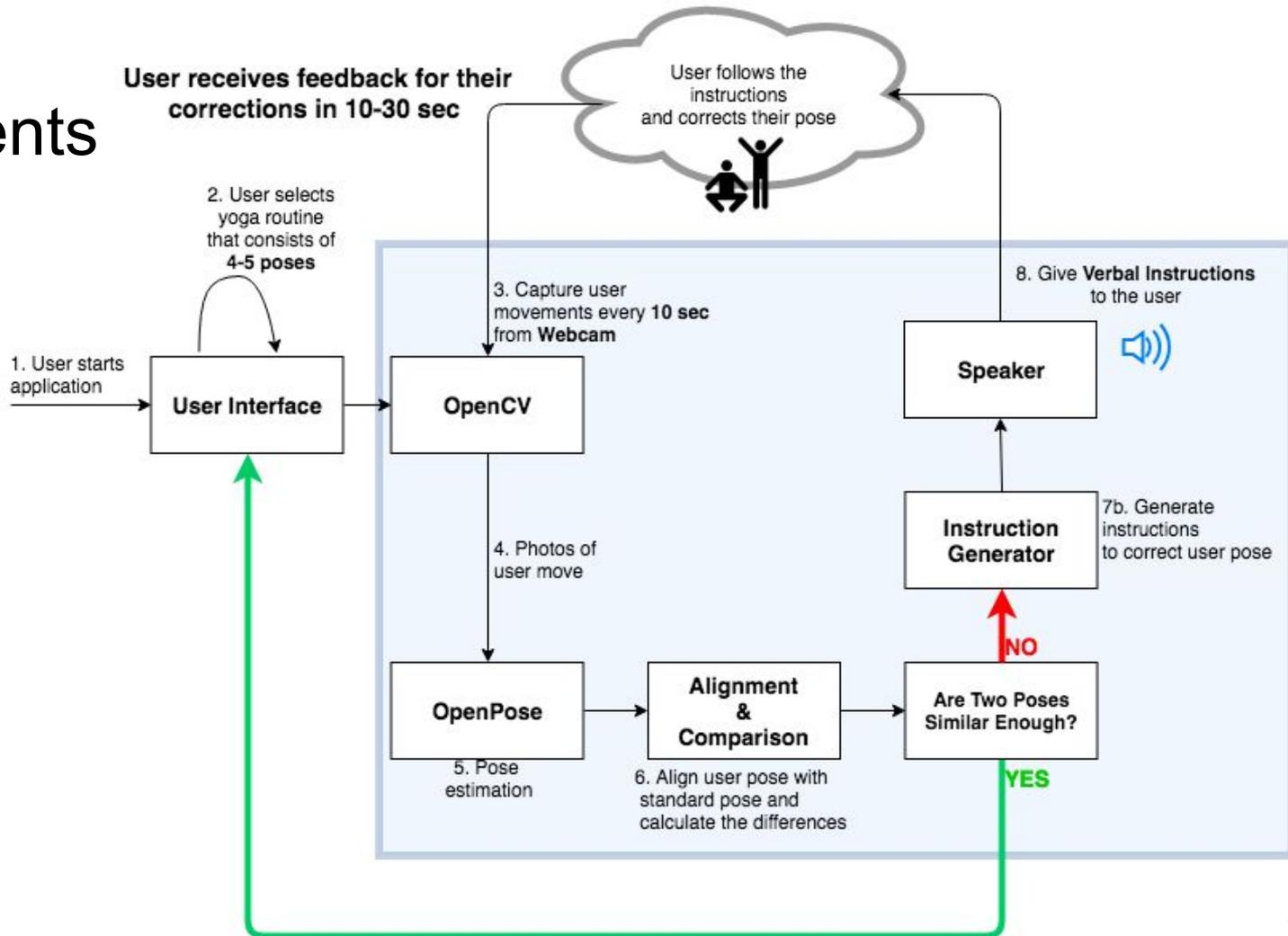
Tian Zhao

# Use case

- Virtual Yoga Coach to minimize injuries during an at-home yoga practice for a single user
- Walk users through 4-5 yoga routines
- Allows users to set the pace at beginning of practice
- Give real-time feedback (verbal and visual cues) to improve the user's practice based on webcam images, user height, arm span, and gender



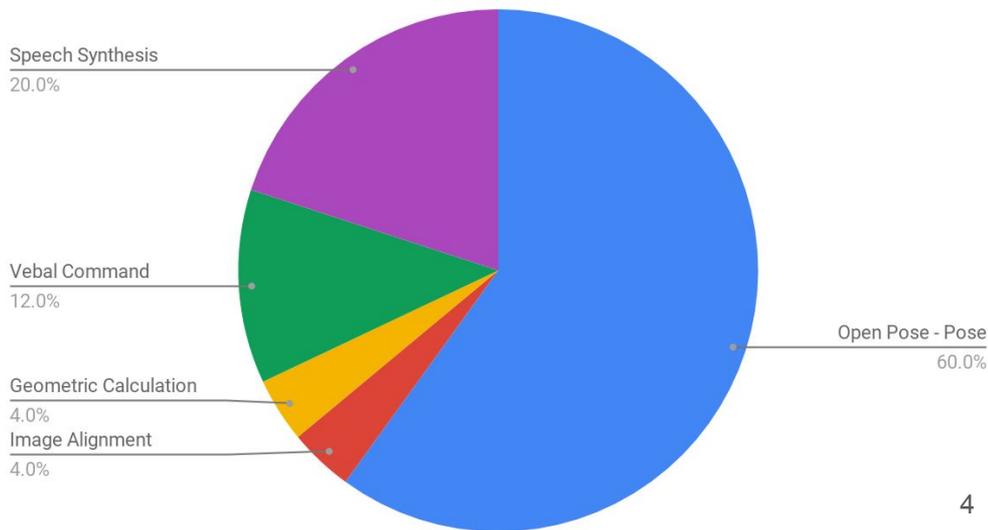
# Requirements



# Requirements (Key Challenge)

- Pose Correction Model:
  - Be generic enough to be applicable to a variety of different yoga poses.
  - Controls for size differences in the images and low camera quality.
- Verbal Instruction Generation
  - Describes motion in a way that a variety of people understand.
  - Converts mathematical data such as angles into easy-to-follow instructions.
  - Gives instructions in appropriate order when multiple limbs are out of place.
- Runtime

Predicted Application Runtime



# Solution Approach - Architecture

## UI

### GUI (PyGame Library)

**OpenCV  
Video Feed**

**Landing Page &  
Menu**

**Yoga Pose  
Routine Picker**

- User picks a few poses

**Visual Feedback**

- Shows proximity to actual pose

### Verbal Interaction

**Verbal Feedback  
(Speech Synthesis)**  
e.g. IBM Watson tts  
API

## Pose Correction Model

### Keypoint Processing Unit

#### OpenPose

- An open source project that extracts Keypoints from images / videos of User Poses

#### Body Structure Mapper

- Relates Keypoints to body structure (arm, forearm, joints, etc.)

#### Additional Features Classifier

- Uses the output of OpenPose to predict more classification questions:  
Is the user lying on their belly?  
Is it a stand pose or a sit pose?

### Pose Comparison Unit (CV)

#### Alignment Unit

- Uses Projection Methods like Harris Corner Detector or Homography to **align** Standard and User Pose

#### Comparison Unit

- Compares the Standard and User Pose and outputs discrepancies in 3D space

### Instruction Unit

#### Instruction Set

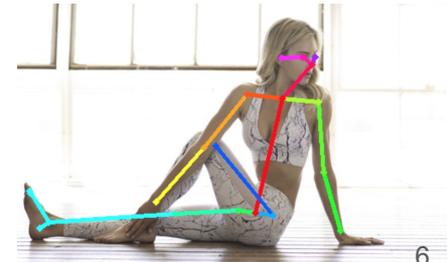
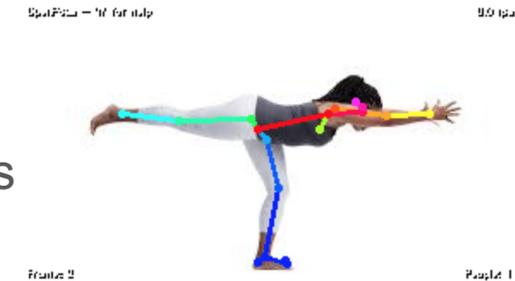
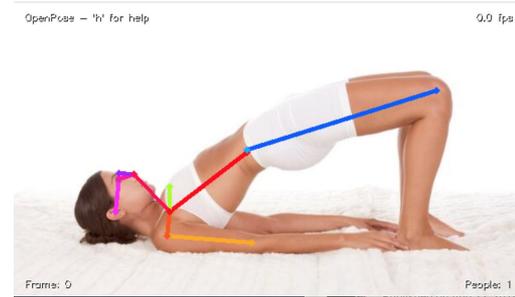
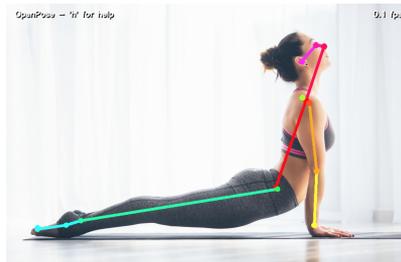
- Summarizes a set of instructions based on popular Yoga poses and human body structure

#### Instruction Generator

- Maps discrepancies from output of Pose Comparison Unit to text instructions

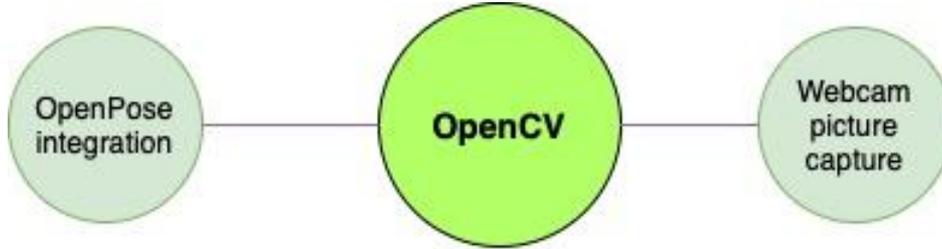
# Solution Approach (Pose Correction)

- Existing Features and Functionality (OpenPose)
  - Compute key points of human poses from images/videos/gifs
  - Estimate face / body / hands / feet from a pose
- Pose Alignment for Standard Affine Transformations/Homography to align the poses
- Computing Geometric Differences for Multiple Body Parts
- Our Generated Pose Estimation on Yoga Poses

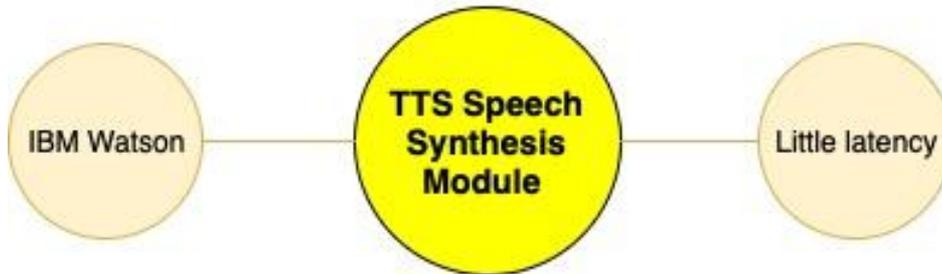


# Solution Approach - Frontend

- Camera feed

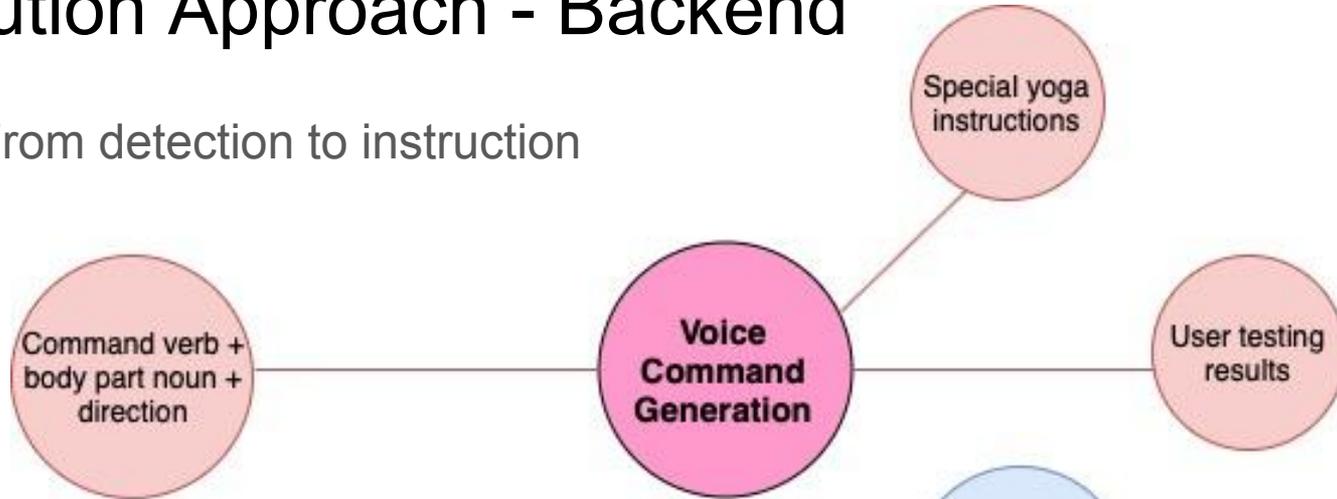


- Instructions to users

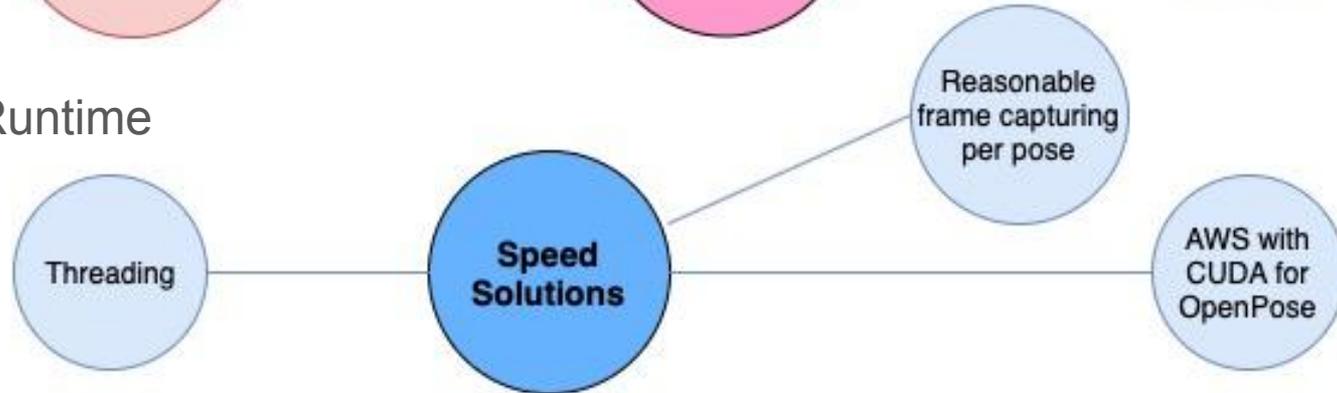


# Solution Approach - Backend

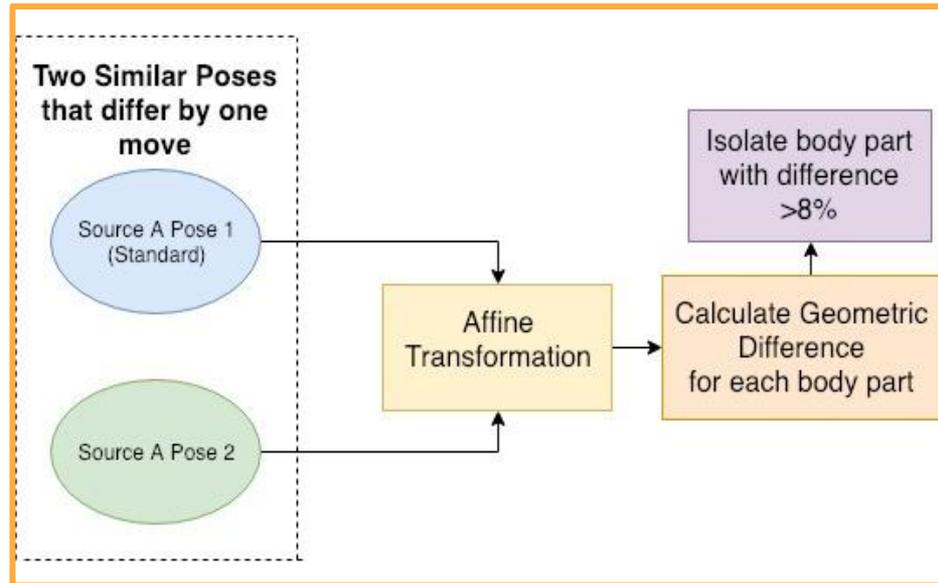
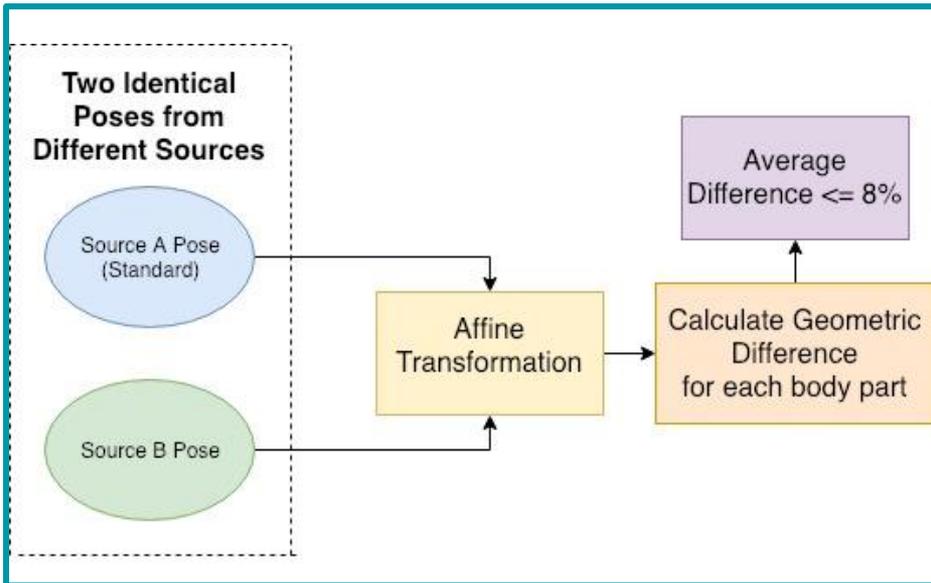
- From detection to instruction



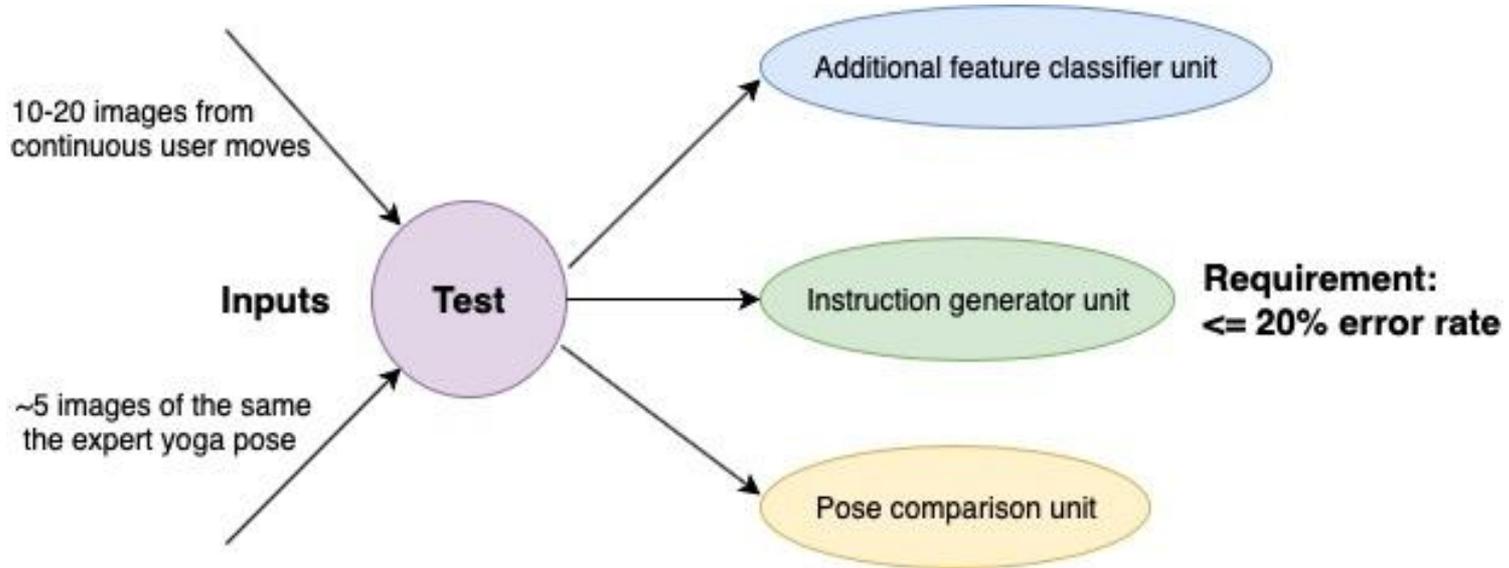
- Runtime



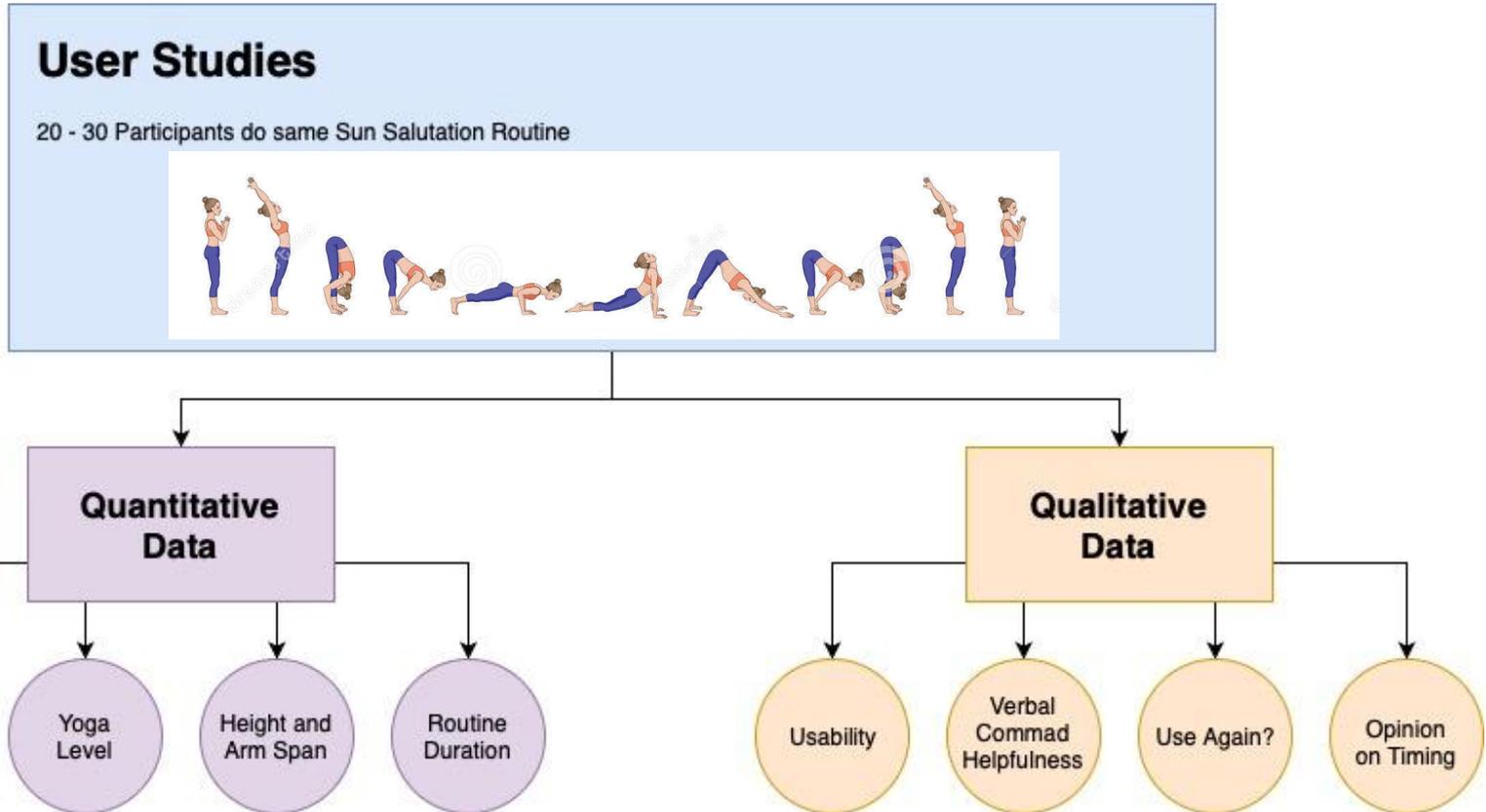
# Testing, Verification and Metrics - Pose Alignment



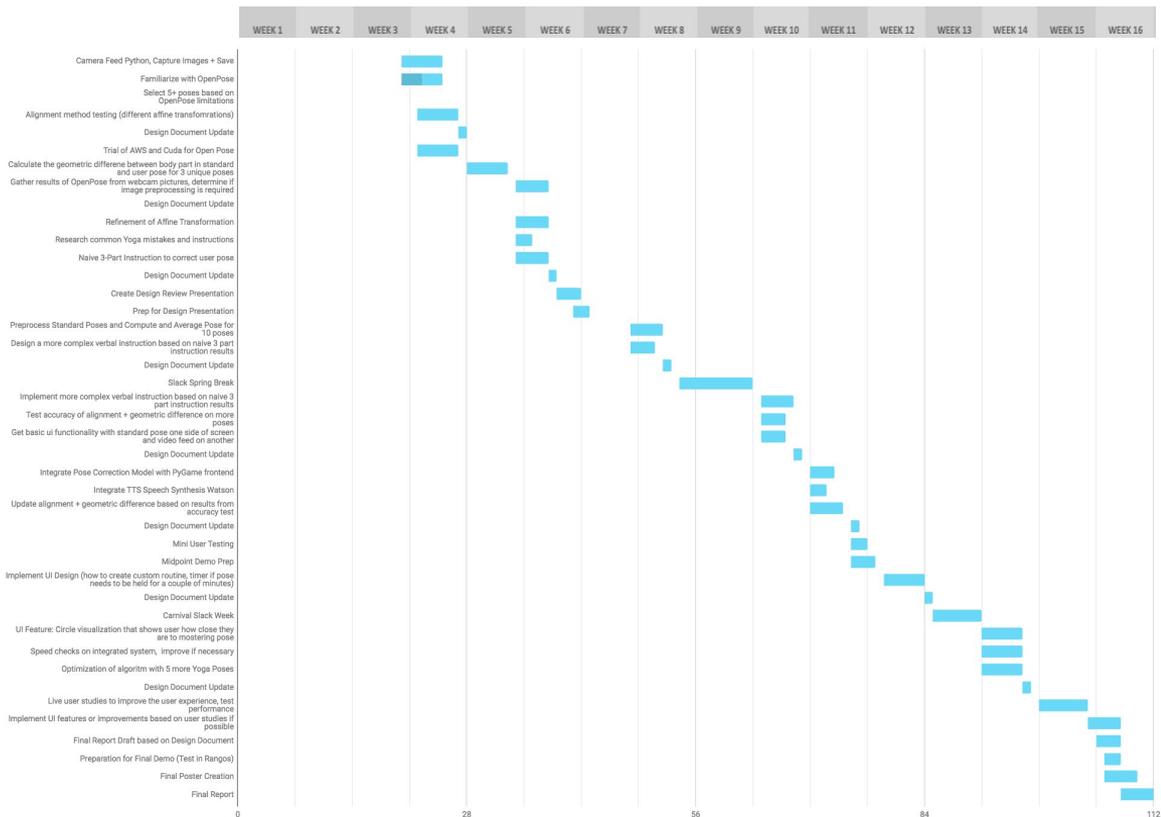
# Testing, Verification and Metrics - Pose Correction



# Testing, Verification and Metrics - Overall Application



# Division of Labor & Schedule



Stakeholder	Component
Chelsea	User Interface
Sandra	Pose Alignment
Tian	OpenPose Integration; Verbal Instructions