



FITIZENS PROJECT

IE MBD CORPORATE PROJECT

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Fitness Sector



AI-Powered Exercise

- Custom exercise plans
- AI Integration

Fitizens

- AI to Boost Athletes & Trainers

Tech in Fitness Industry

- Wearable Devices
- Computer Vision & Detector Tech



Our Focus



Goal:

- Instant Live Exercise Recognition

Pre-Trained Models

- Transfer Learning
 - Pre-Trained Model

Available Datasets

- Kintetics 400
- Alternatives

- Models:

- OpenVINO
- MediaPipe

KINETICS 400



- Human Activities sourced from Youtube
- 400+ Human Action Classes
- Variety of Pre-Trained Models

Alternatives:

- **HMDB51**
- **UCF101**
- **ExerciseNTU**
- **PoseTrack**

Model Architecture



6 Step Implementation



Preprocessing

- Frame Preprocessing
- Encoder Inference

Action Recognition

- Vector Pack Assembly
- Decoder Analysis

Repetition Counter

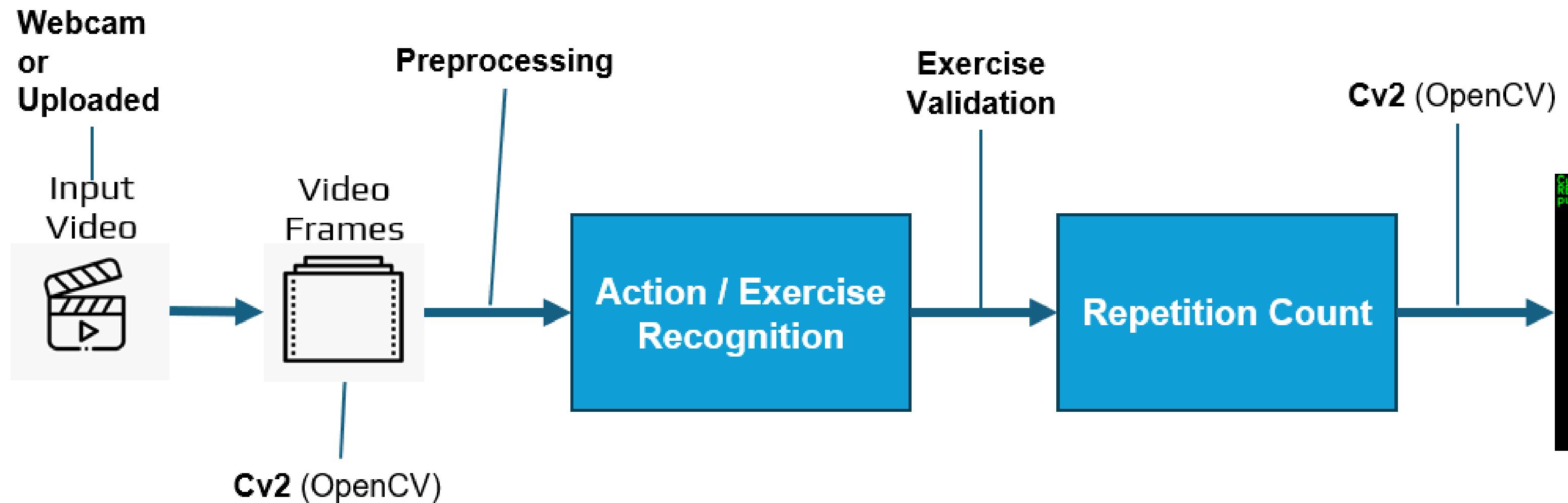
- Angle Calculation
- Repetition Counting

Video Input

- Flexible Video Input

Output

- Frame to Video



™

Skeleton-Based
Recognition Models

 MediaPipe

Body Landmark
Extraction



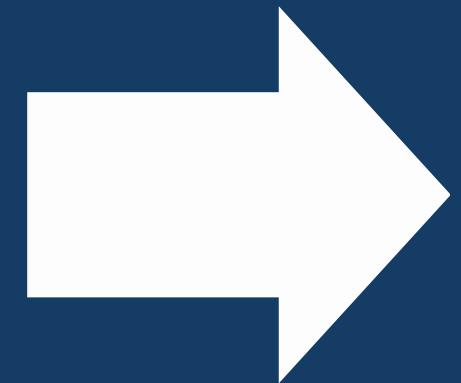
PreProcessing

- Frame is Duplicated
 - Original used in Counting
- Locate and center Body on frame
- Frames are Cropped/Resized for encoder



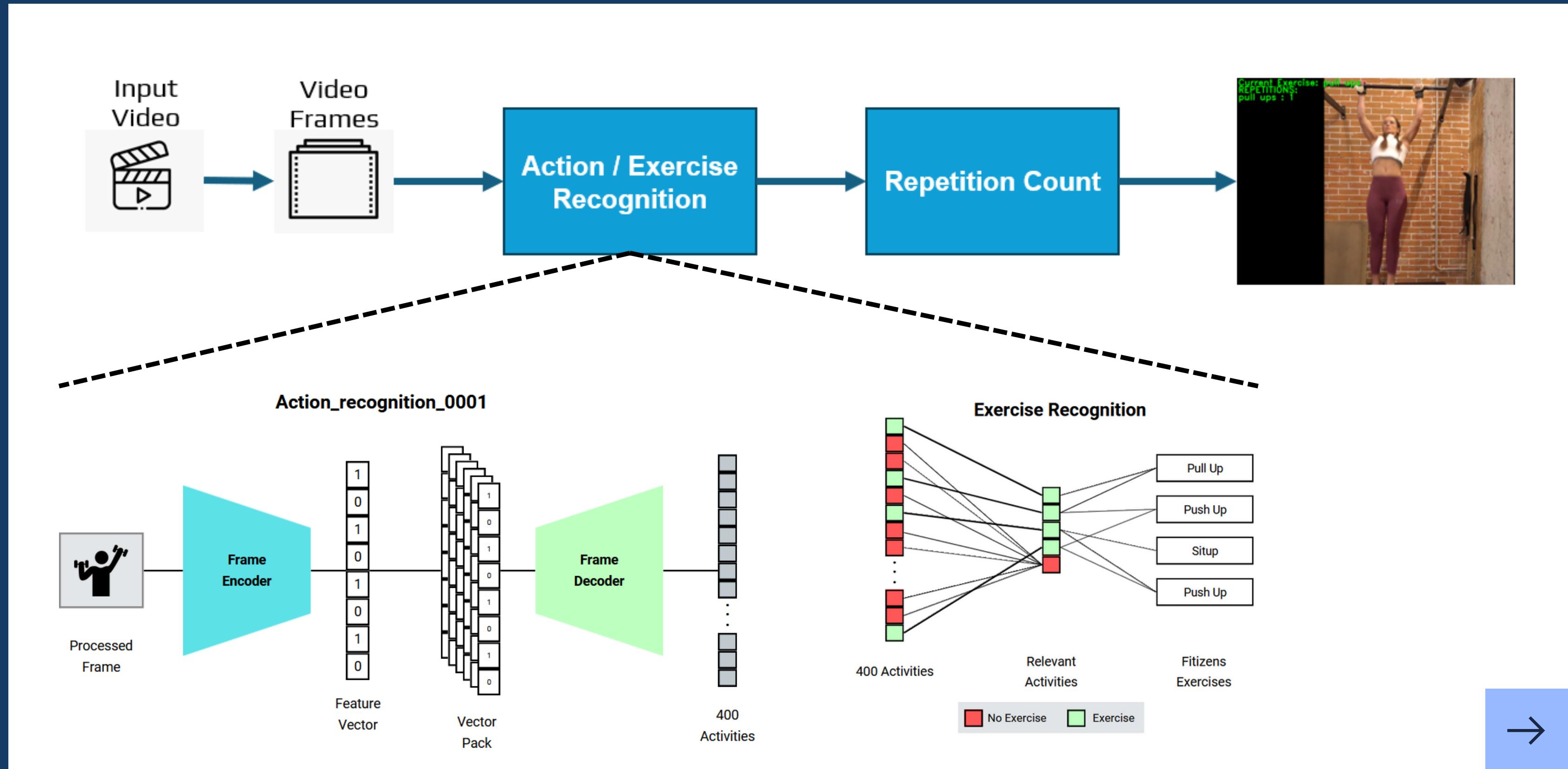


Original Video Input

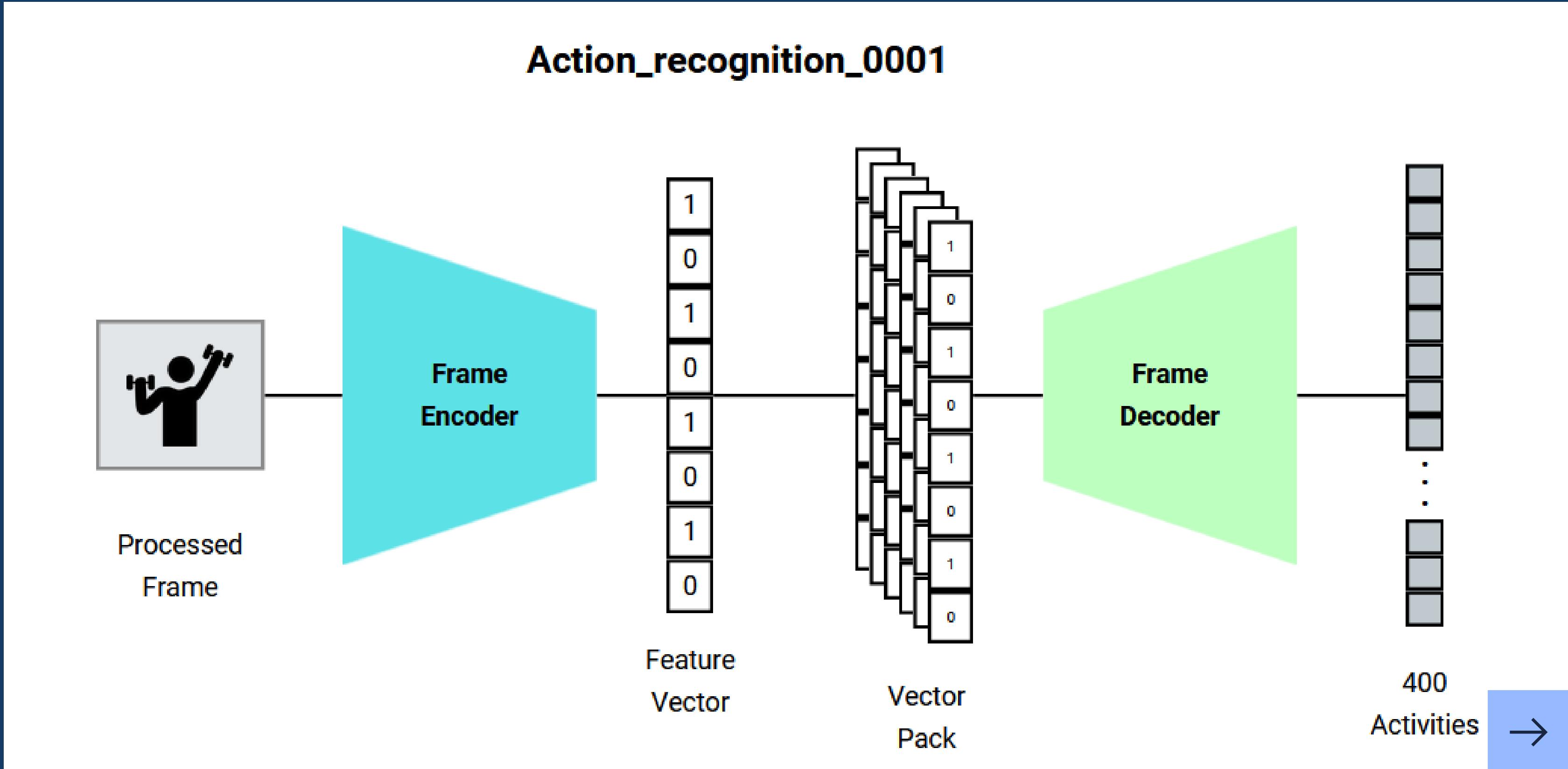


PreProcessed Video

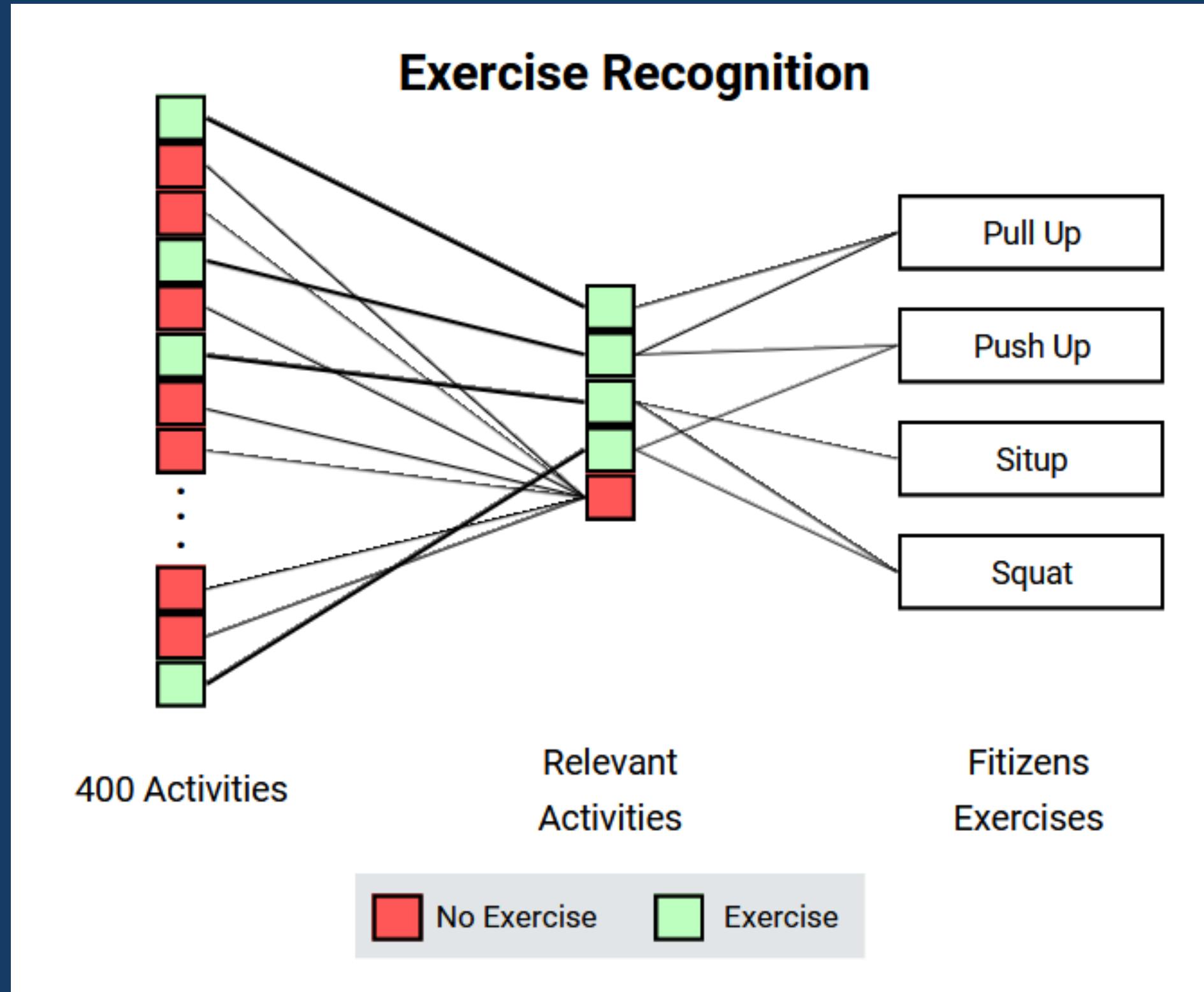
Action Recognition



Action Recognition



Exercise Recognition

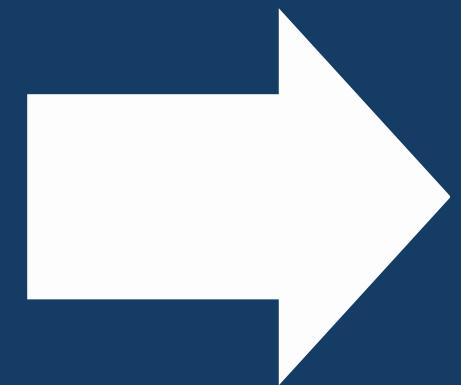


- Grouped Irrelevant Activities
 - “No Excercise”
- Custom Classification Logic



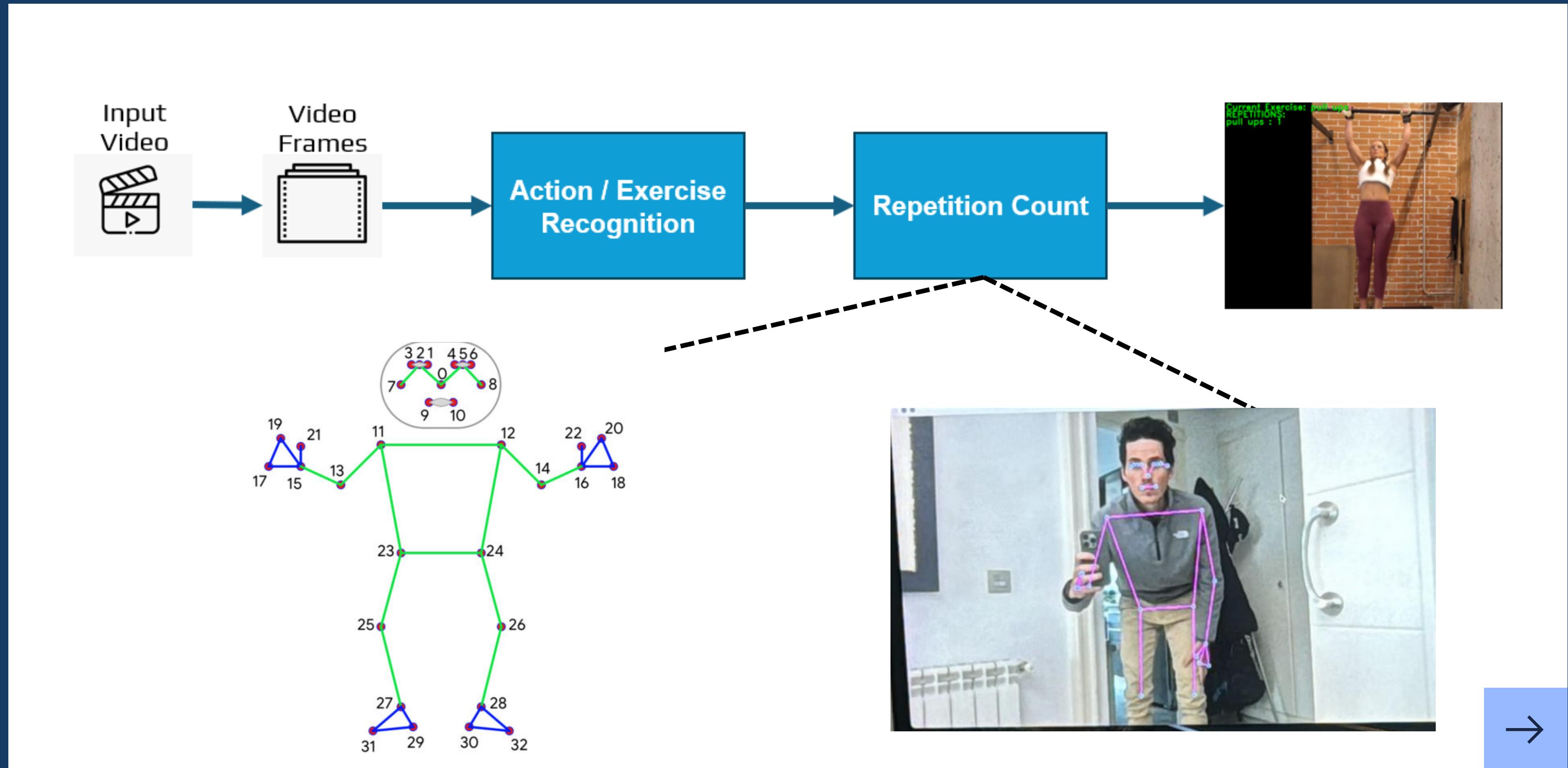


Multiple Actions
Recognized

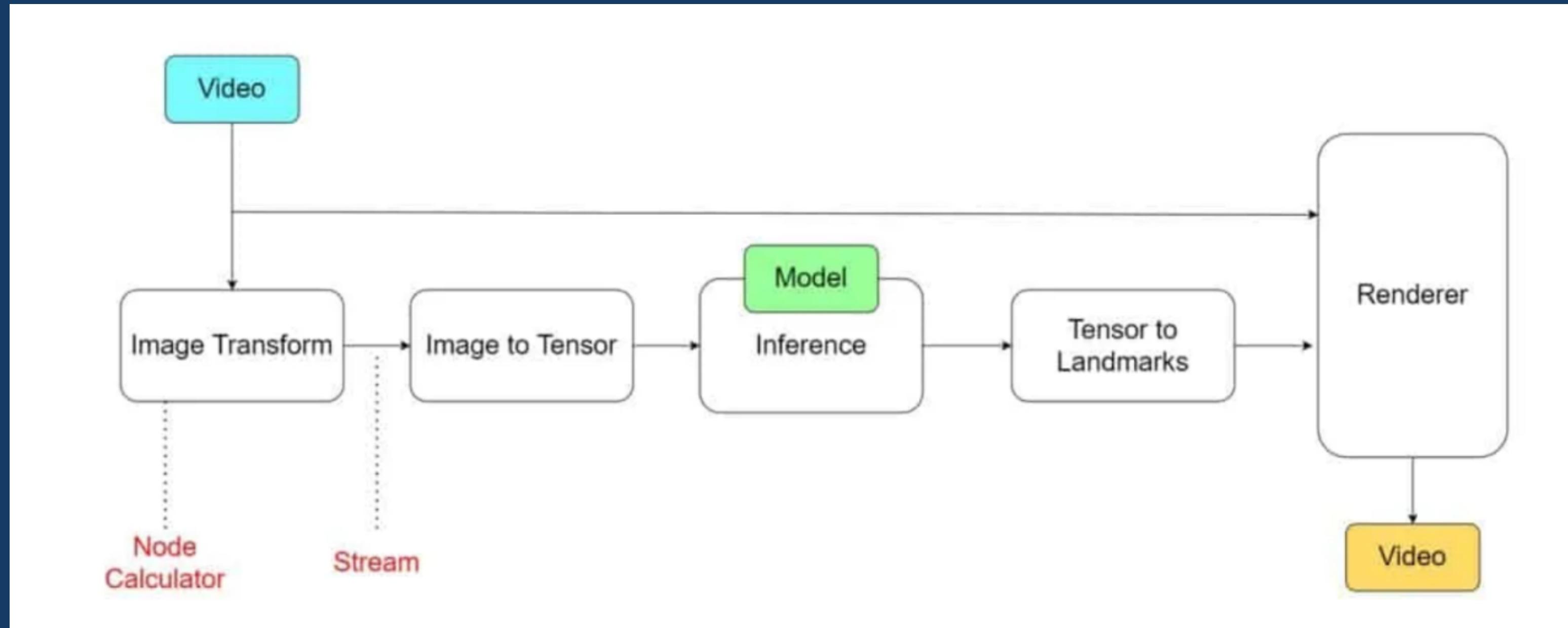


Exercise Recognized

Repetition Count



Pose Detection Model



- 2 Stages

- 33 Landmarks





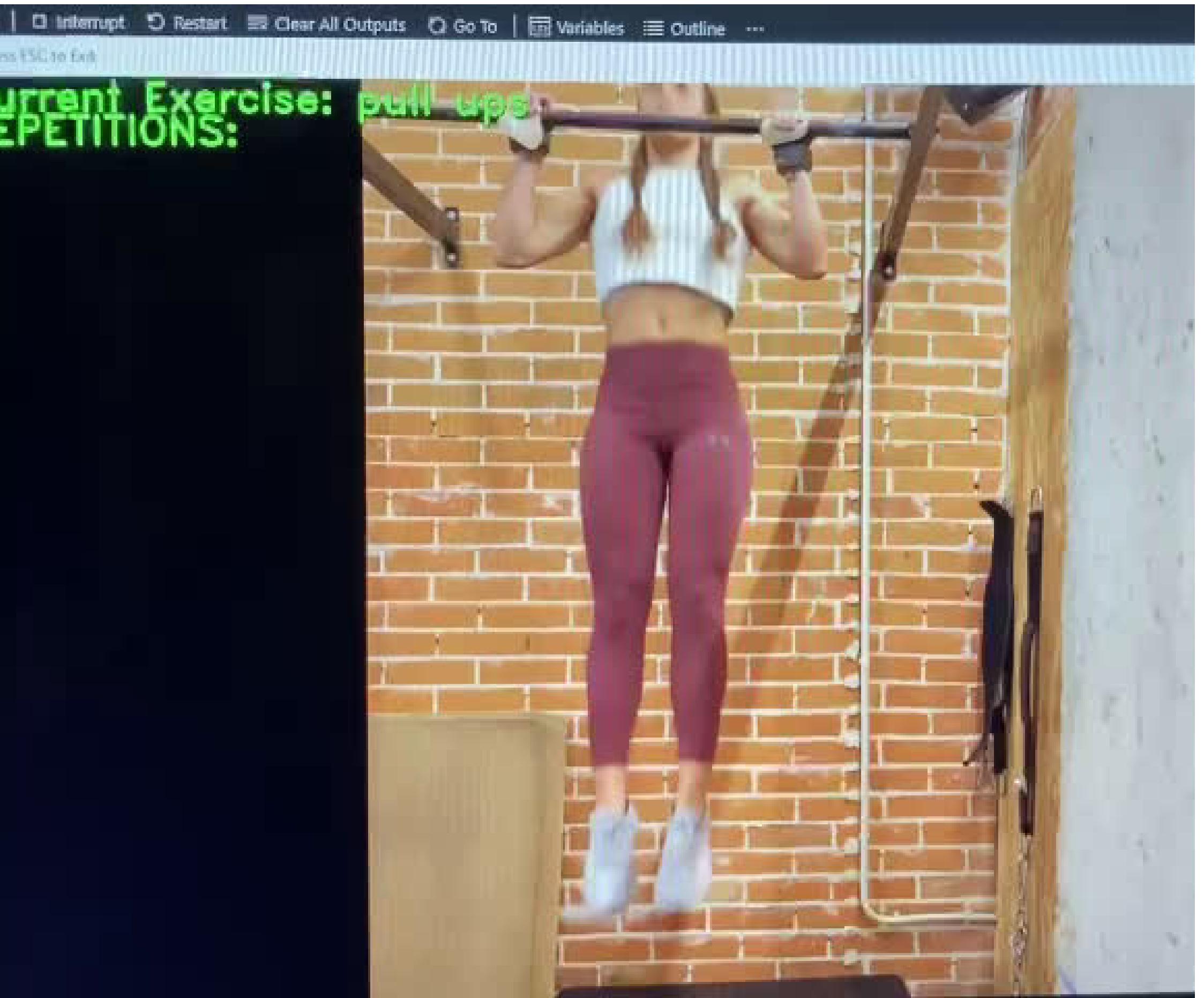


Count Repetitions & Exercises Algorithm

- Two-Step logic
 - Extension & Contraction
- Angles Created
- Body Part Relevance Varies on Exercise



FINAL MODEL



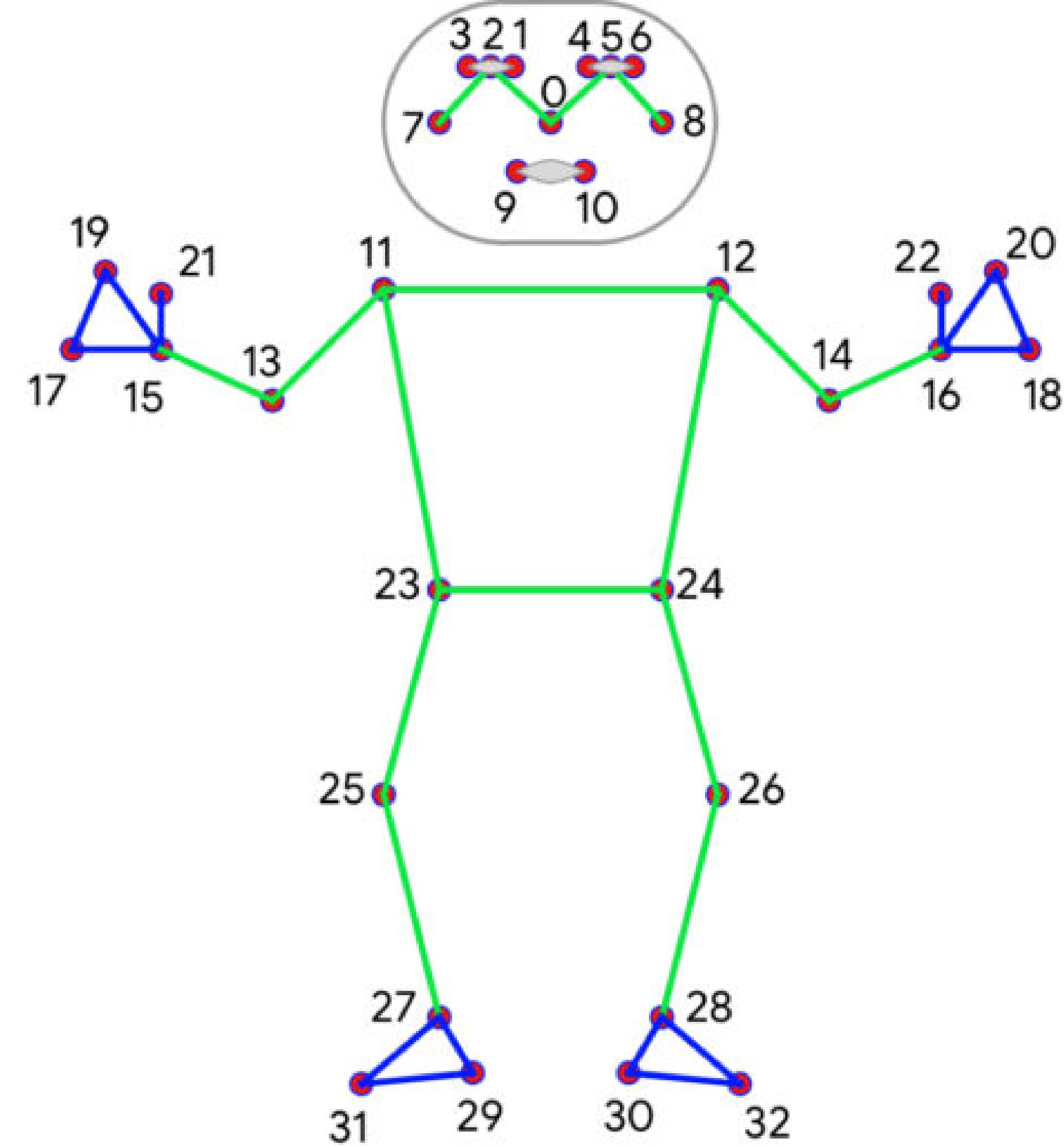
MediaPipe

- 2 Stages:
 - Pose Detection & Landmarking
- Angle Detection



Alternatives:

- RepNet
 - Counts repetitions
 - Poor Performance
 - Installation Process



Talking phone right - 100.00%



OpenVINO

- Variable Models and Frameworks
- Limitation: Intel Hardware



Alternative:

- **MMAAction2**
 - Pre-Trained Models
 - Single-Action per Video
 - Installation Process



Limitations & Suggestions





Frames Per Second (FPS) & Action Speed

- Model rewards Conscious exercise
- Dependent on Input FPS and Athlete Action Speed
- Low/High & High/Low FPS vs Speed impact in a negative way
- **Suggestion:**
 - User Guide
 - Adjustable Model (FP32)
 - Adjustable Frames Skipping





MultiStep Exercise

- Example: Burpees
- Only one action detected, not the whole action
- ***Suggestion:***
 - Fine-Tune Model using ML Classification Layer
 - Datasets and Labels are needed to train

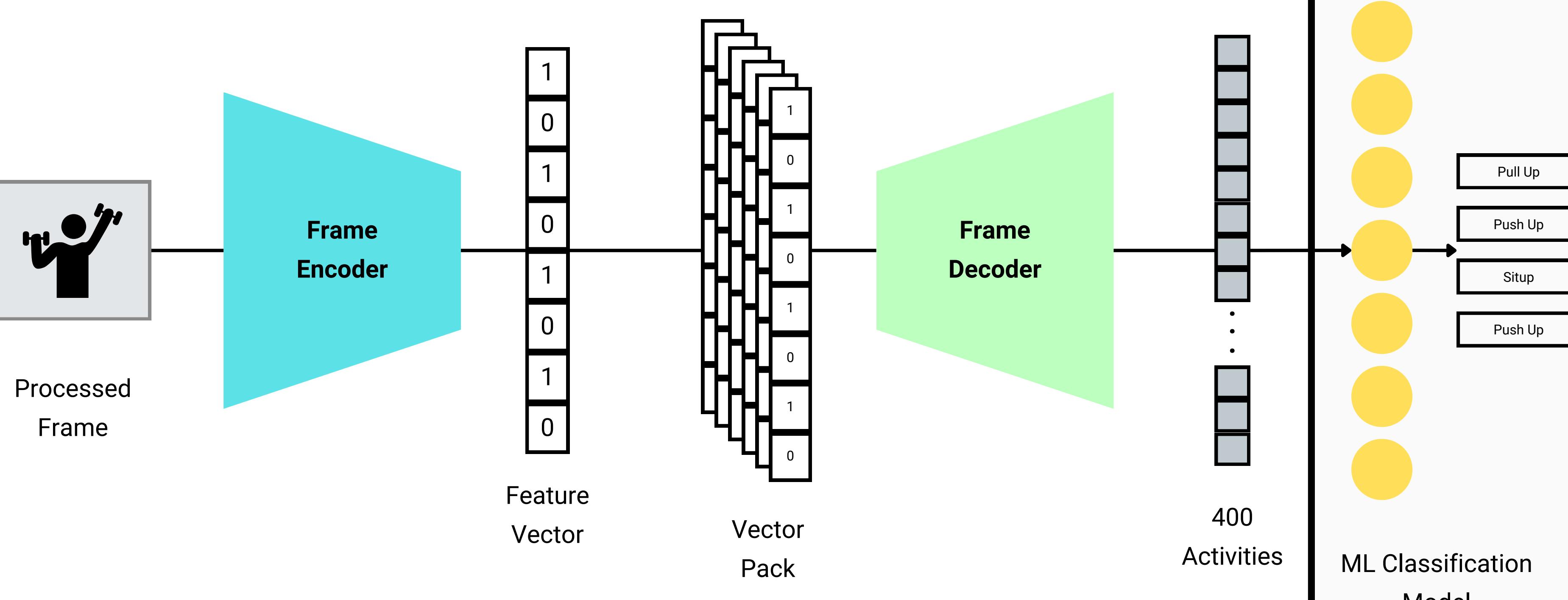


Fine-Tuning →



Fine Tuning

Action_recognition_0001





Single Person Action

- If more than one person is in the frame, the outcome is likely to be affected.
- **Suggestion:**
 - Create Initial Layer to detect Humans
 - Create Instances of the model for each detection
 - Requires High Computational Power



TRAINING



Retrain per Exercise

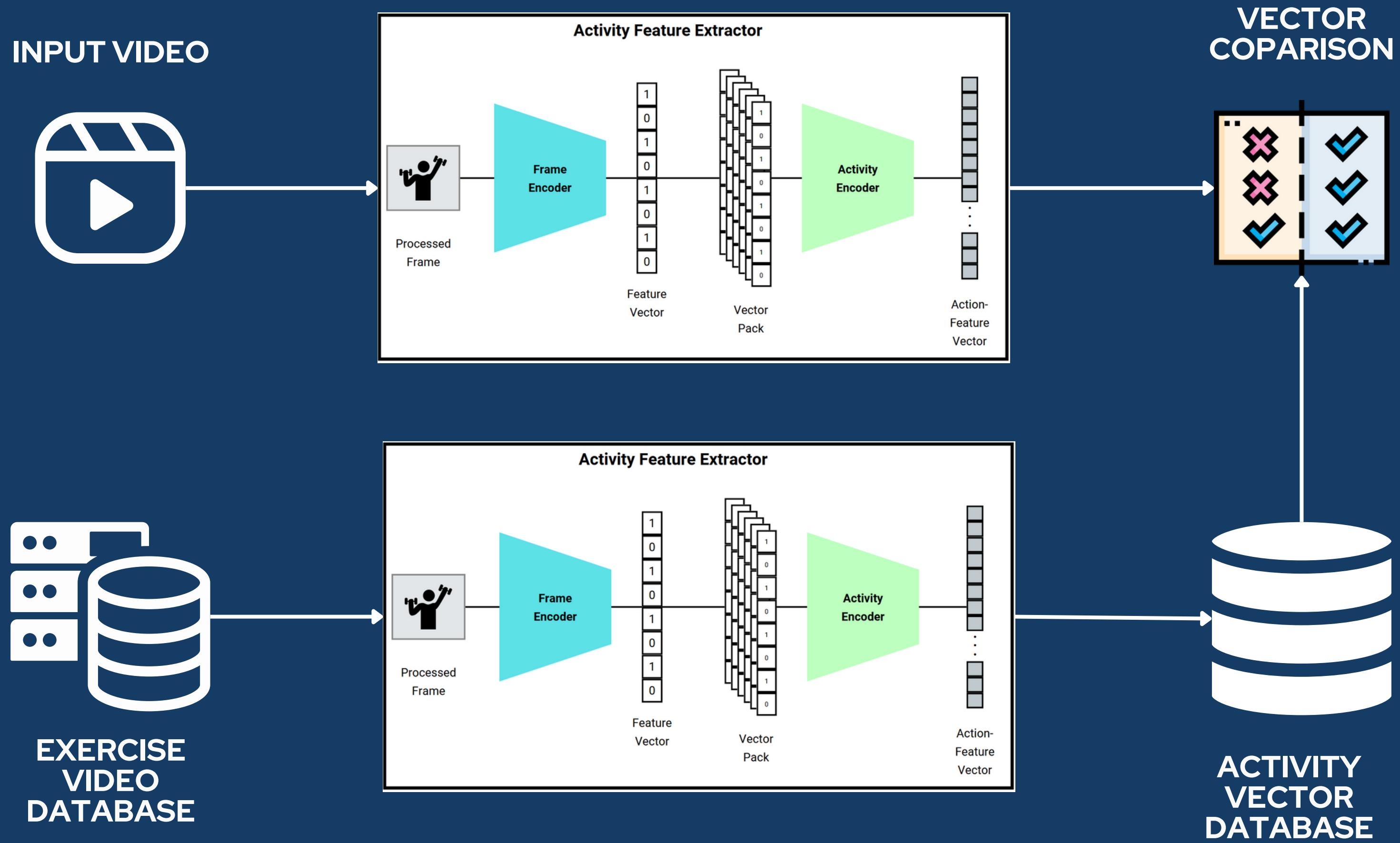
- If a new exercise is required the Classification must be retrained.
 - Hardcoded or ML Model
- High Resources and Technical Knowledge
- **Suggestion:**
 - Few-Shot Model not requiring training
 - Ambitious Approach in Specific Domain



Few-Shot
Learning



Few-Shot Learning



Thank You.

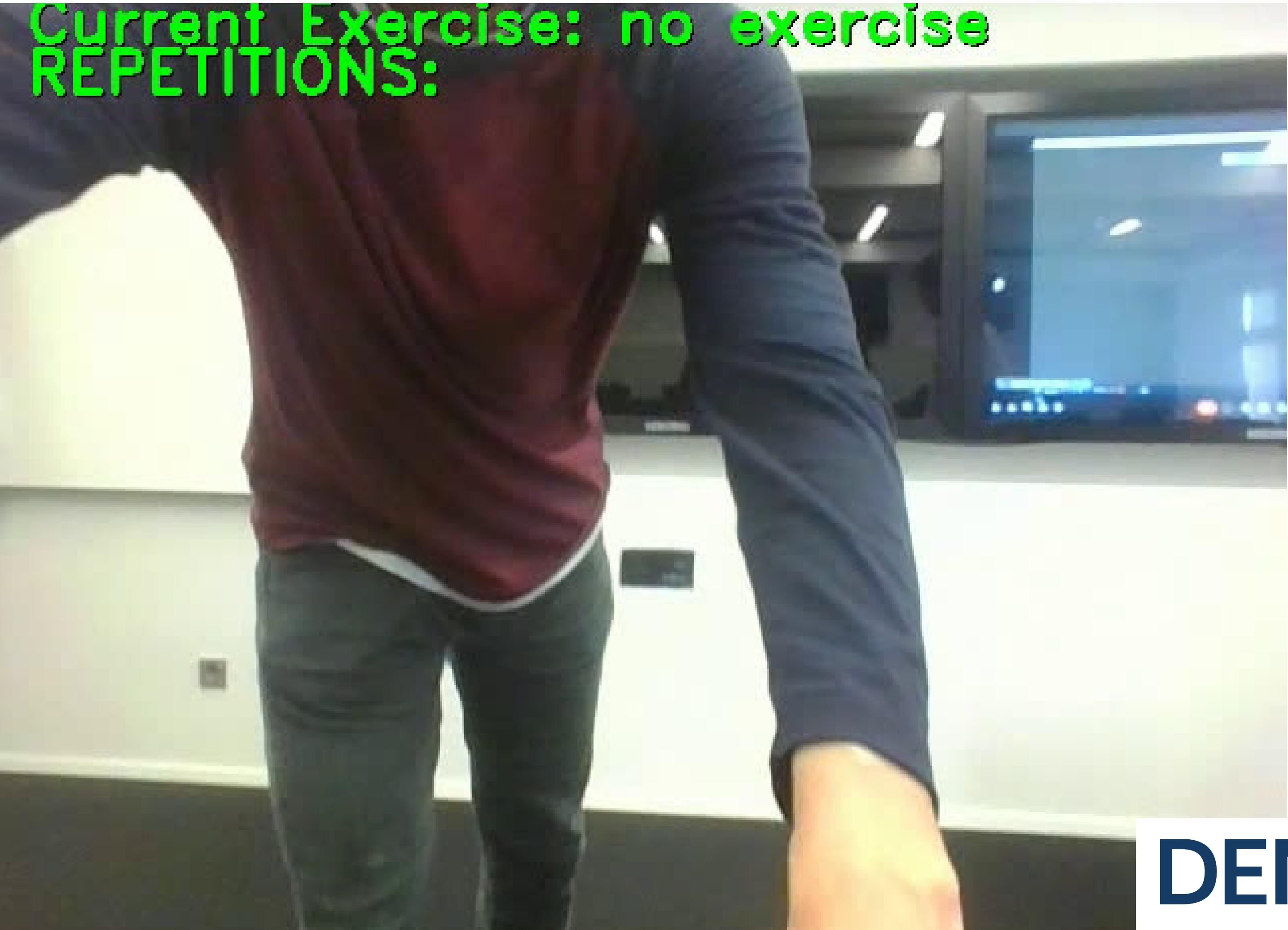
Any
Questions?



Appendices

[Github Repository](#)

**Current Exercise: no exercise
REPETITIONS:**



DEMO