Squash Game Phase Detection through Motion Tracking

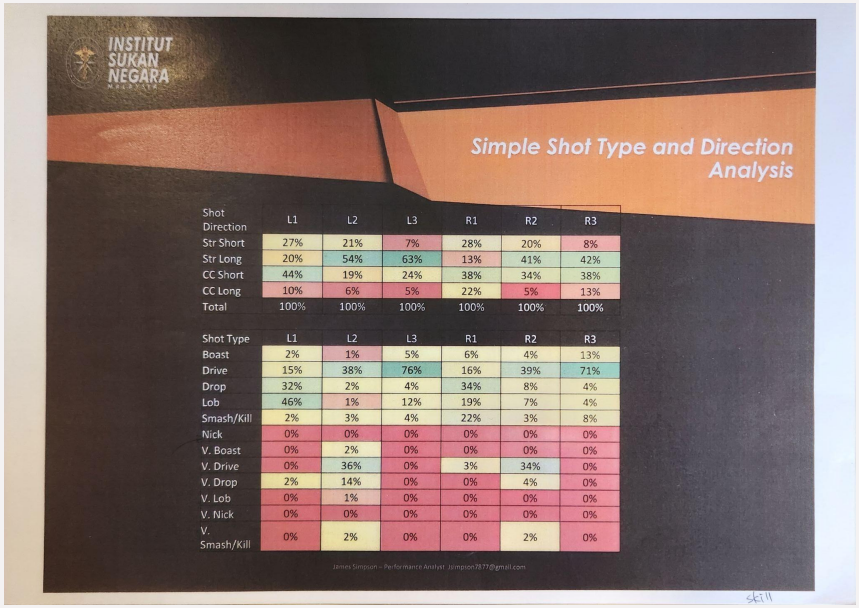
EE 4080 - Final Year Project

Junyeong Heo (55960131)

Outline

- **Introduction**
- Project Architecture Overview
- Processing stages
  - Preprocessing stage
  - Segmentation process
  - Pose detection process
  - Analysis and export stage
- Conclusion

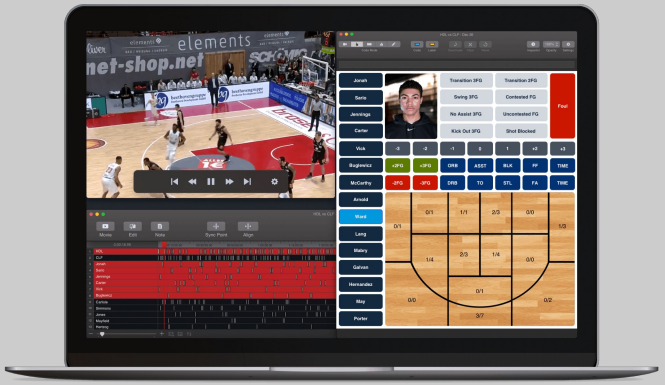
Introduction



Shot Direction	L1	L2	L3	R1	R2	R3
Str Short	27%	21%	7%	28%	20%	8%
Str Long	20%	54%	63%	13%	41%	42%
CC Short	44%	19%	24%	38%	34%	38%
CC Long	10%	6%	5%	22%	5%	13%
Total	100%	100%	100%	100%	100%	100%

Shot Type	L1	L2	L3	R1	R2	R3
Boast	2%	1%	5%	6%	4%	13%
Drive	15%	38%	76%	16%	39%	71%
Drop	32%	2%	4%	34%	8%	4%
Lob	46%	1%	12%	19%	7%	4%
Smash/Kill	2%	3%	4%	22%	3%	8%
Nick	0%	0%	0%	0%	0%	0%
V. Boast	0%	2%	0%	0%	0%	0%
V. Drive	0%	36%	0%	3%	34%	0%
V. Drop	2%	14%	0%	0%	4%	0%
V. Lob	0%	1%	0%	0%	0%	0%
V. Nick	0%	0%	0%	0%	0%	0%
V. Smash/Kill	0%	2%	0%	0%	2%	0%

hudlsportscode



https://www.hudl.com/en_gb/products/sportscode

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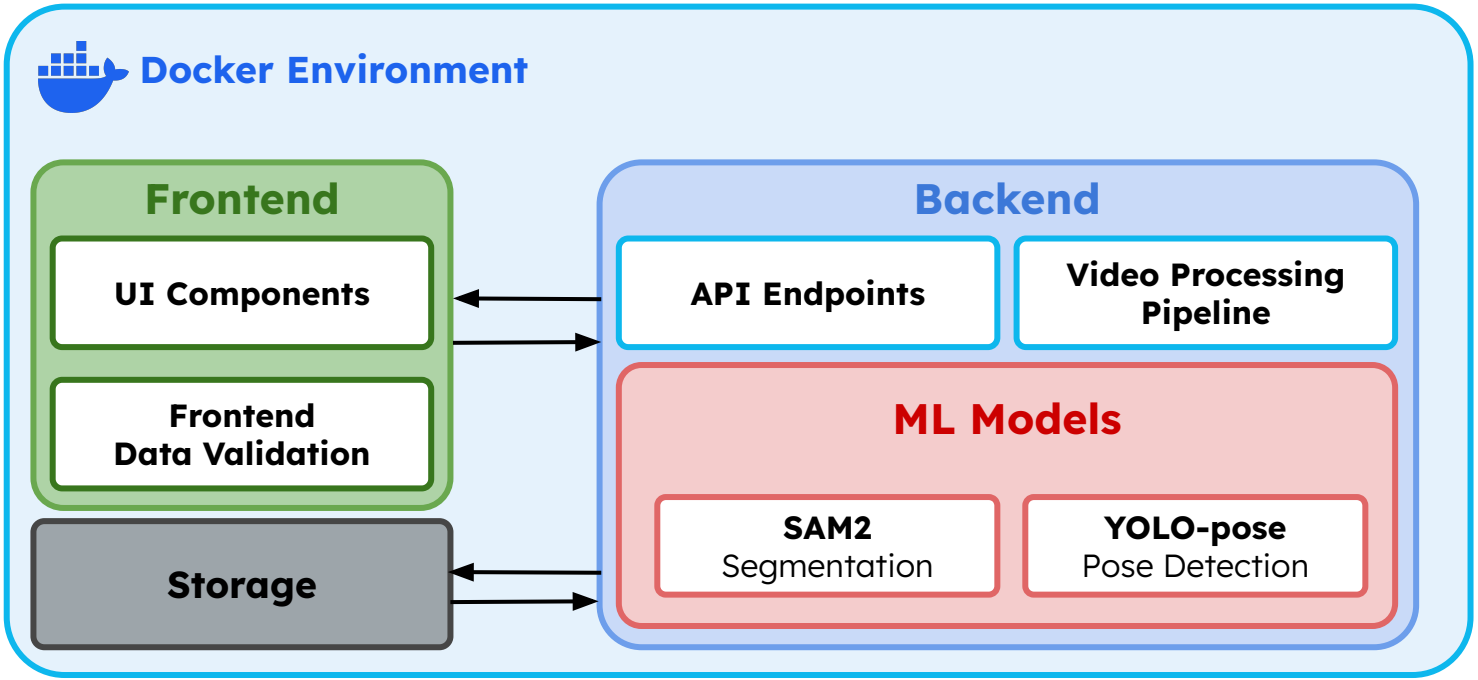
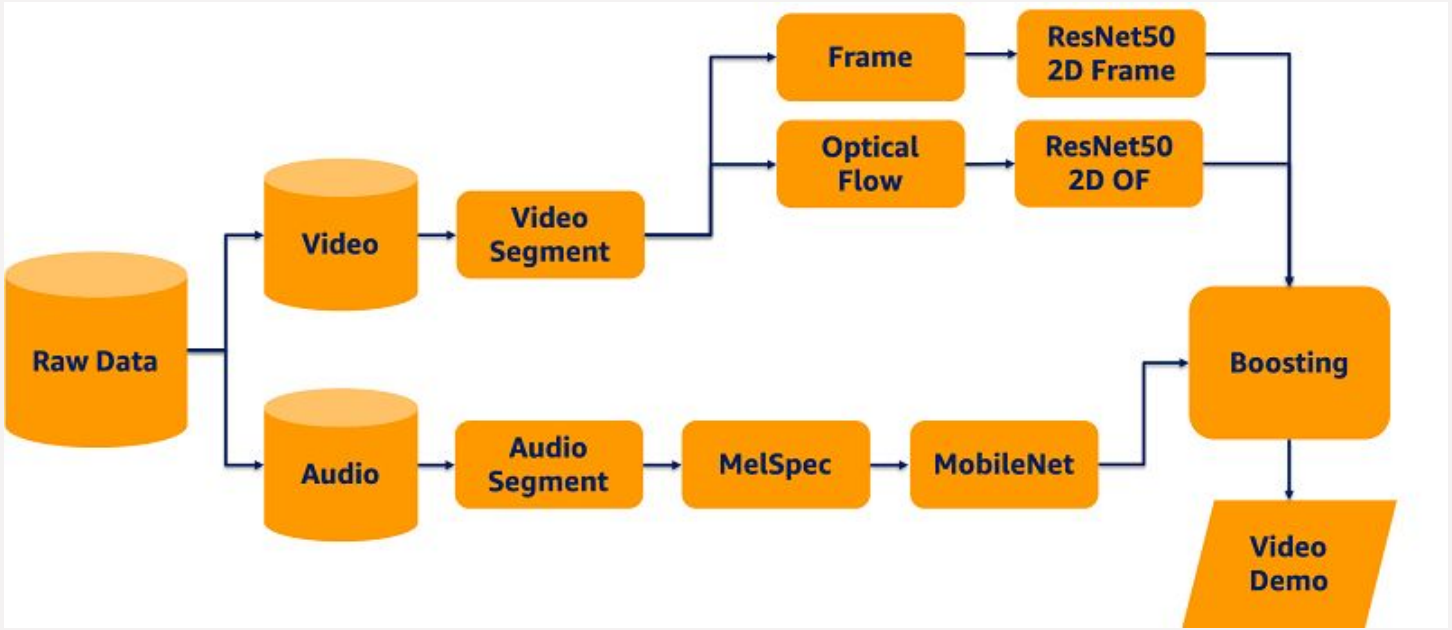
Project Architecture Overview

Frontend and Backend Architectures



Project Architecture Overview

Project Pipeline motivation

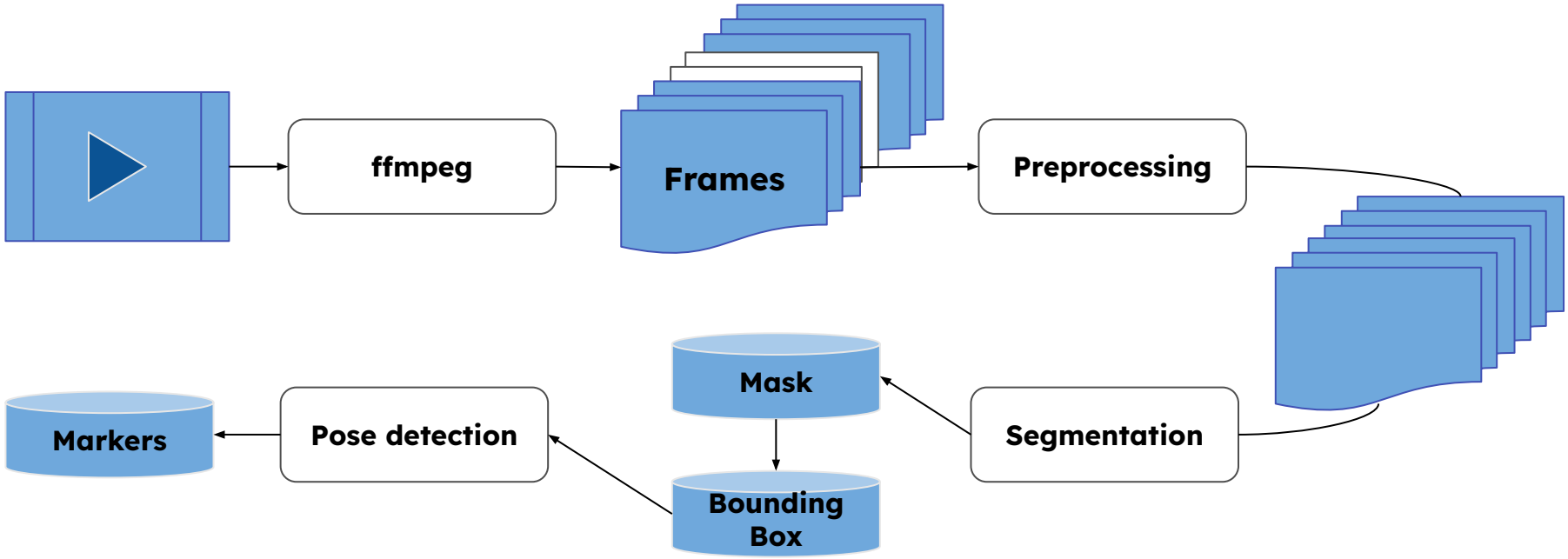


Multimodal deep learning approach for event detection in sports using Amazon SageMaker

https://aws.amazon.com/blogs/machine-learning/multimodal-deep-learning-approach-for-event-detection-in-sports-using-amazon-sagemaker/

Project Architecture Overview

Project Pipeline



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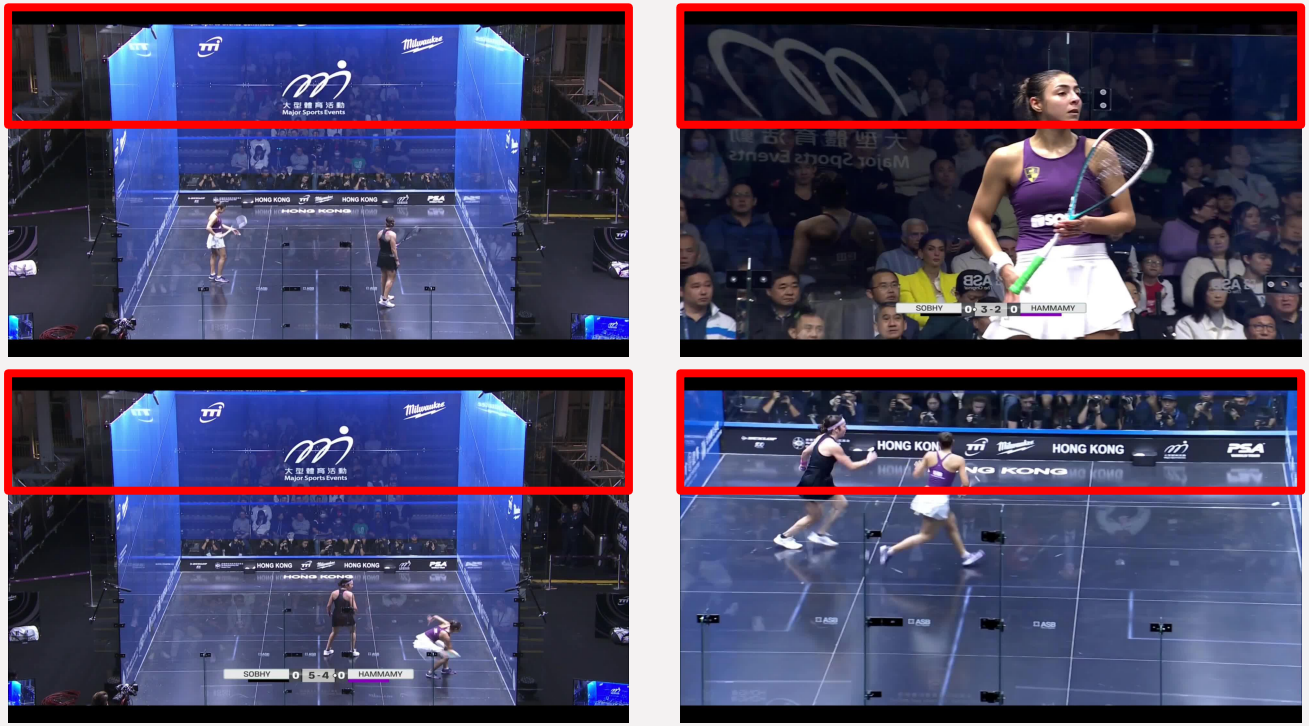
Preprocessing process

Processing overview

Examples of main angles and alternate angles

Preprocessing process

Examples



Examples of main angles and alternate angles

Preprocessing process

Frontend and Backend Architectures

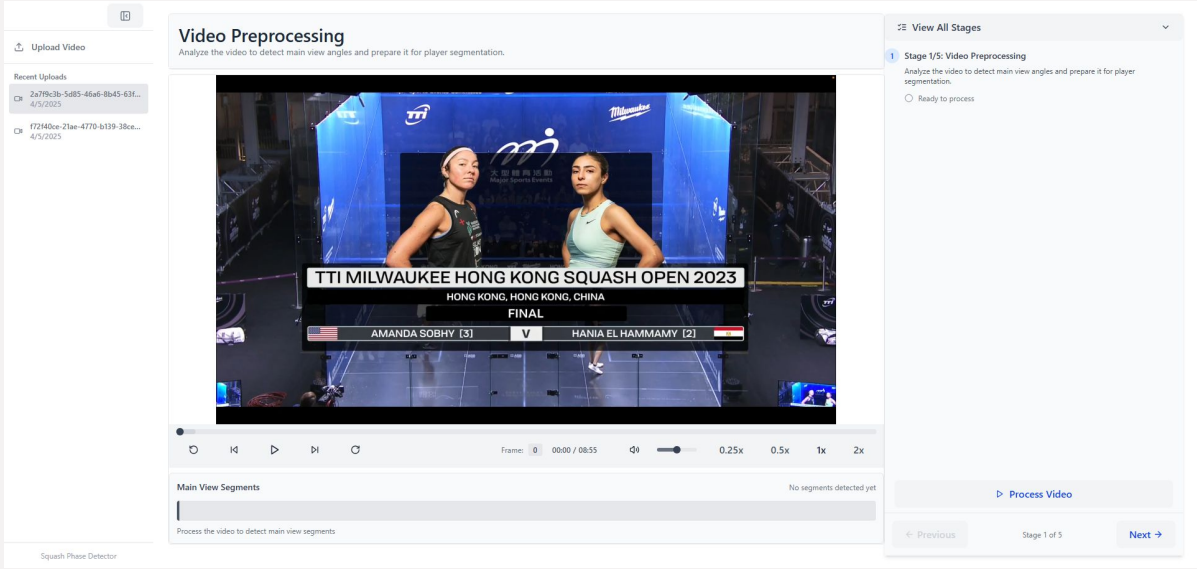


Image hash algorithms

(Python ImageHash)

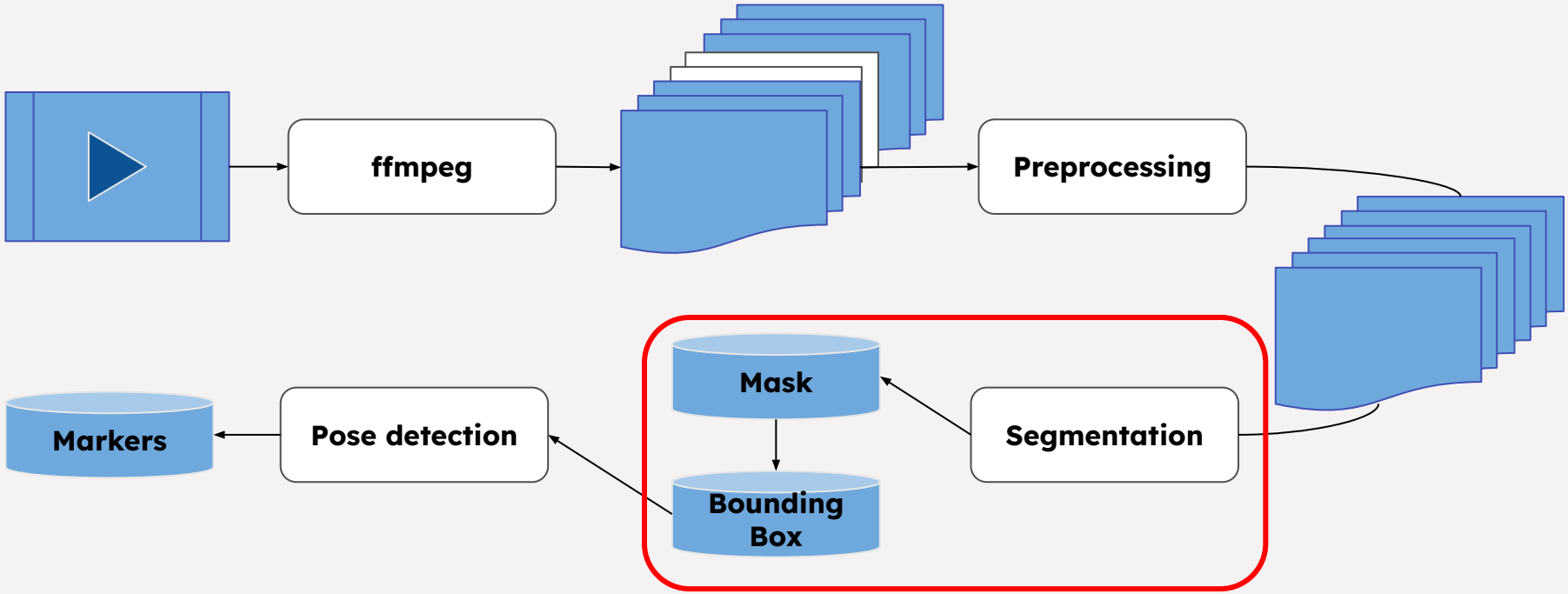
- Average hashing
- **Perceptual hashing**
- Difference hashing
- Wavelet hashing
- HSV color hashing (colorhash)
- Crop-resistant hashing

Optimization

- Sampling
  - Select every 5 frames
  - Only storing hash value
- 10-bit threshold ~ 15.6% (64-bit hash)

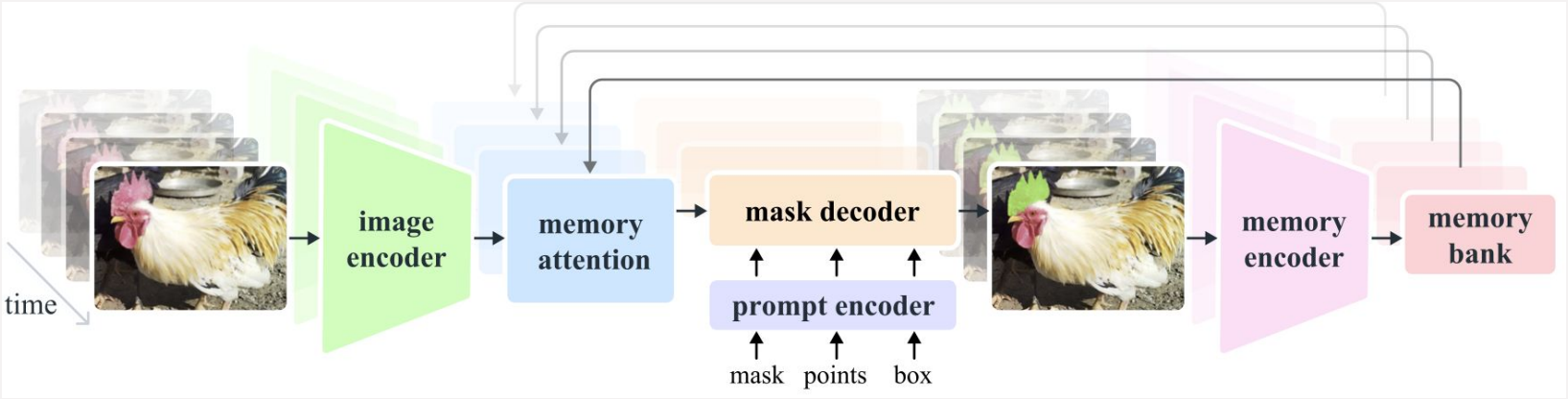
Project Architecture Overview

Project Pipeline



Segmentation process

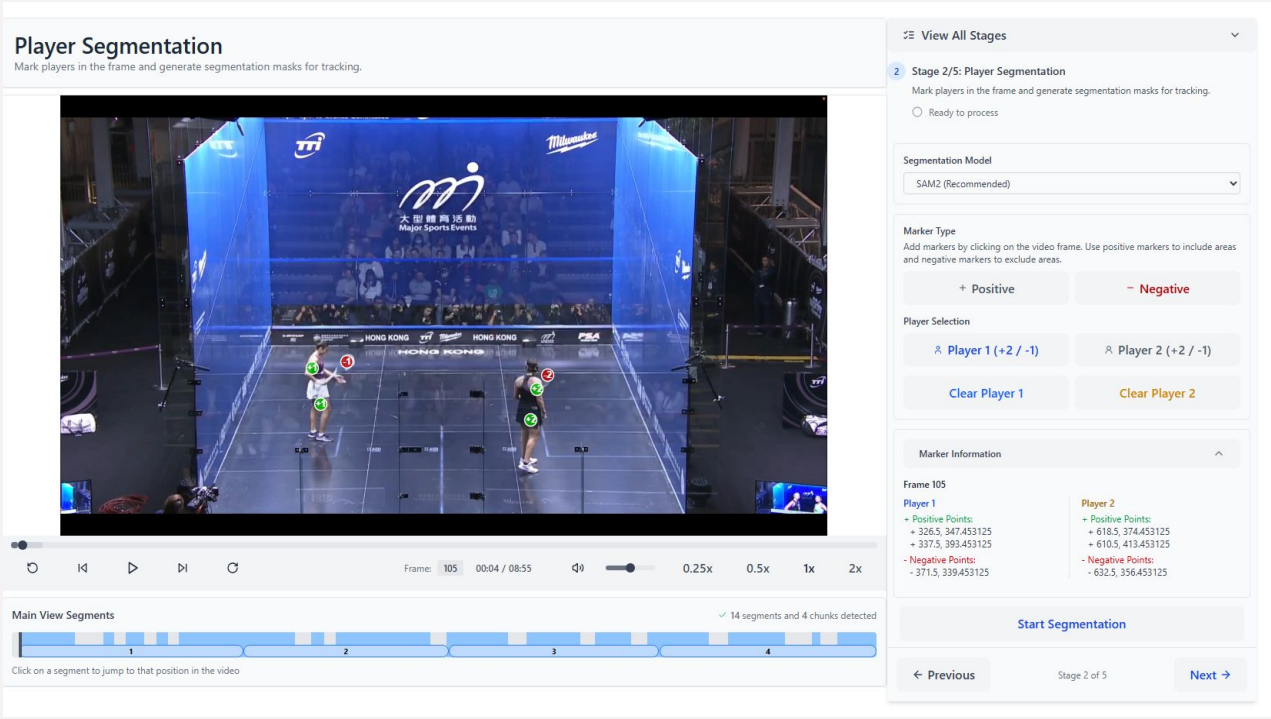
Model Introduction

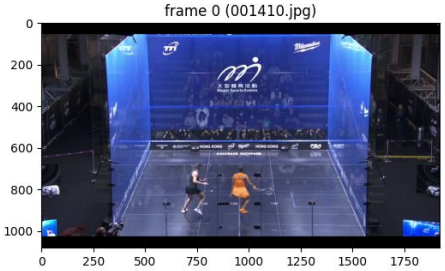


Segment Anything Model 2 (SAM 2) Architecture
https://github.com/facebookresearch/sam2

Segmentation process

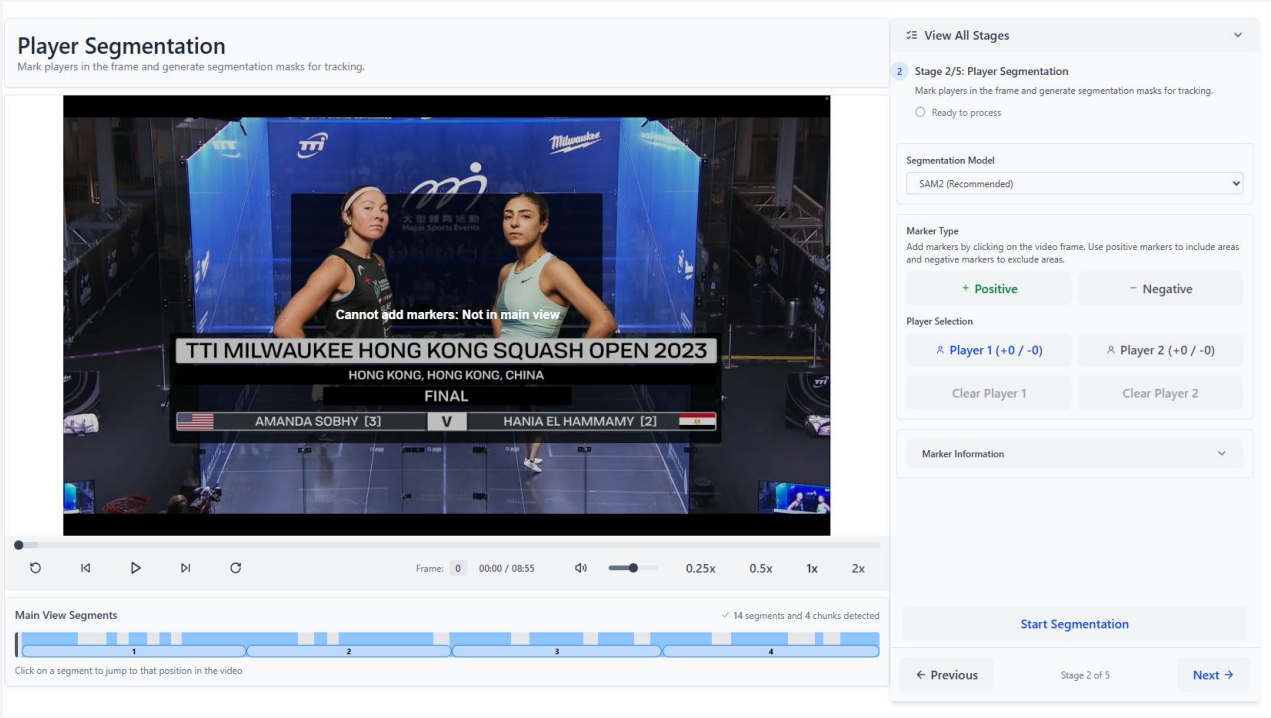
Frontend and Backend Architectures

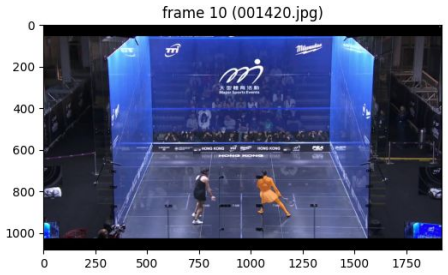




Segmentation process

Frontend and Backend Architectures





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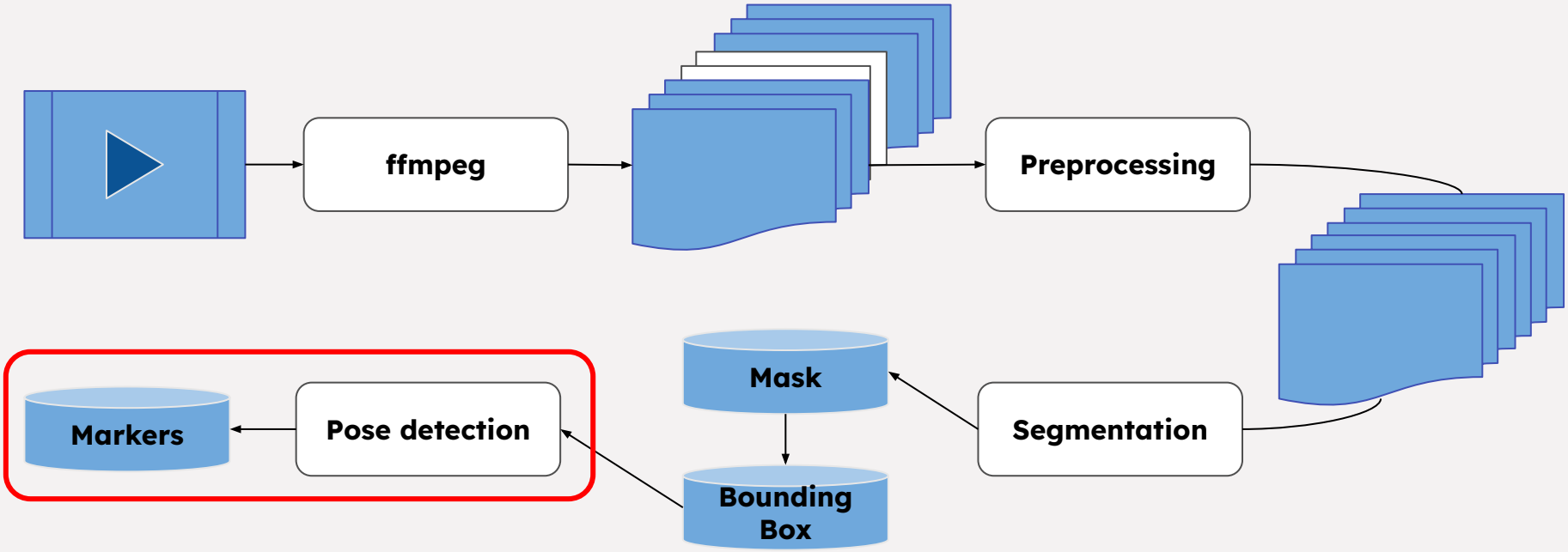
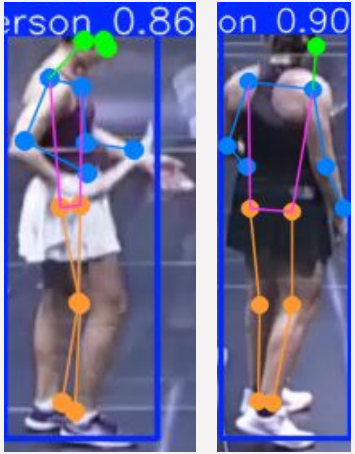


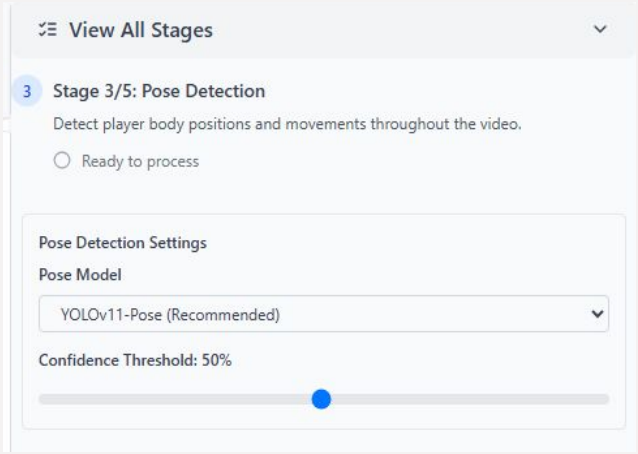
Pose detection process

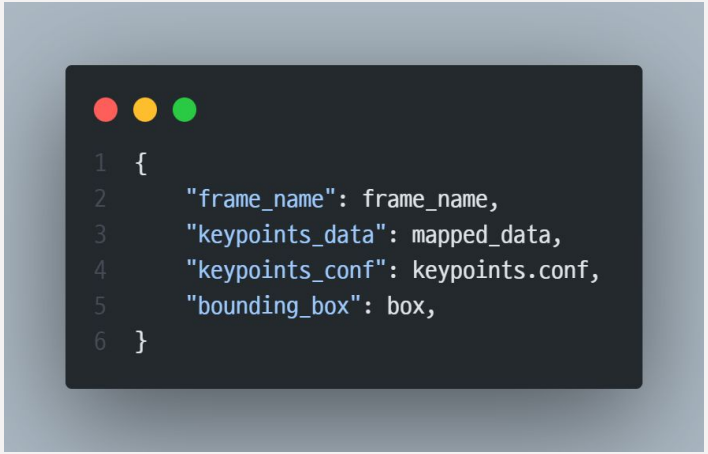
Frontend and Backend Architectures

ultralytics

Ultralytics YOLO 11





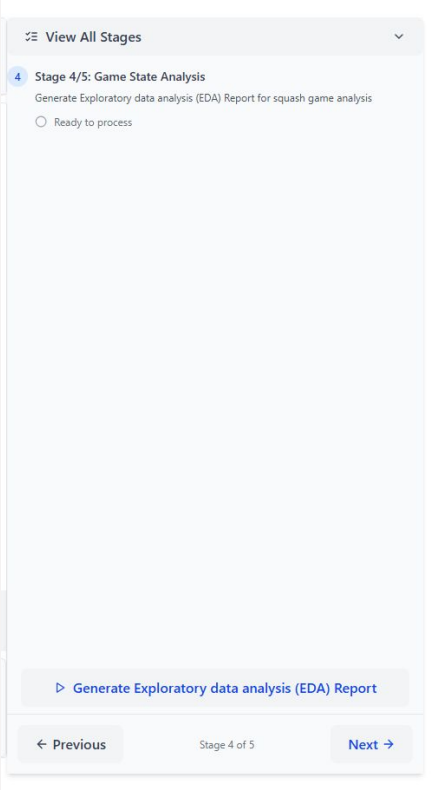


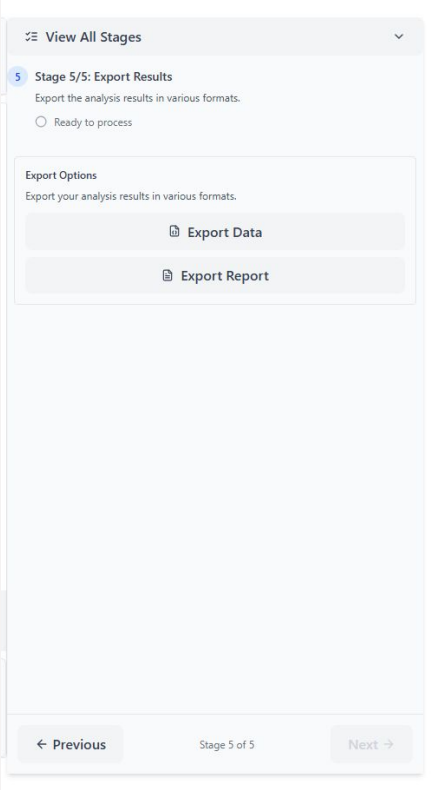
```
{
    "frame_name": frame_name,
    "keypoints_data": mapped_data,
    "keypoints_conf": keypoints.conf,
    "bounding_box": box,
}
```

Analysis and export stage

Frontend Interfaces

Exploratory Data Analysis (EDA)





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