

Squash Game Phase Detection through Motion Tracking

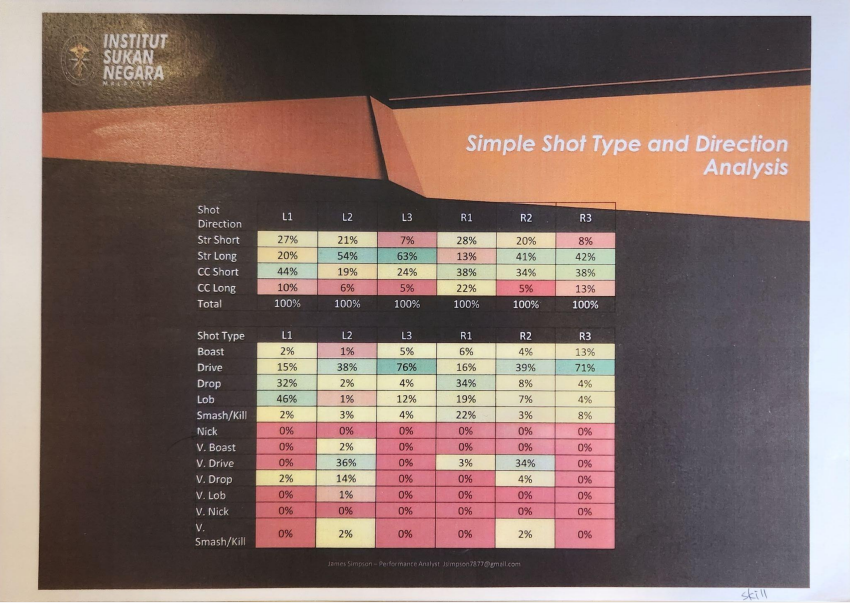
EE 4080 - Final Year Project

Junyeong Heo (55960131)

Outline

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

Introduction







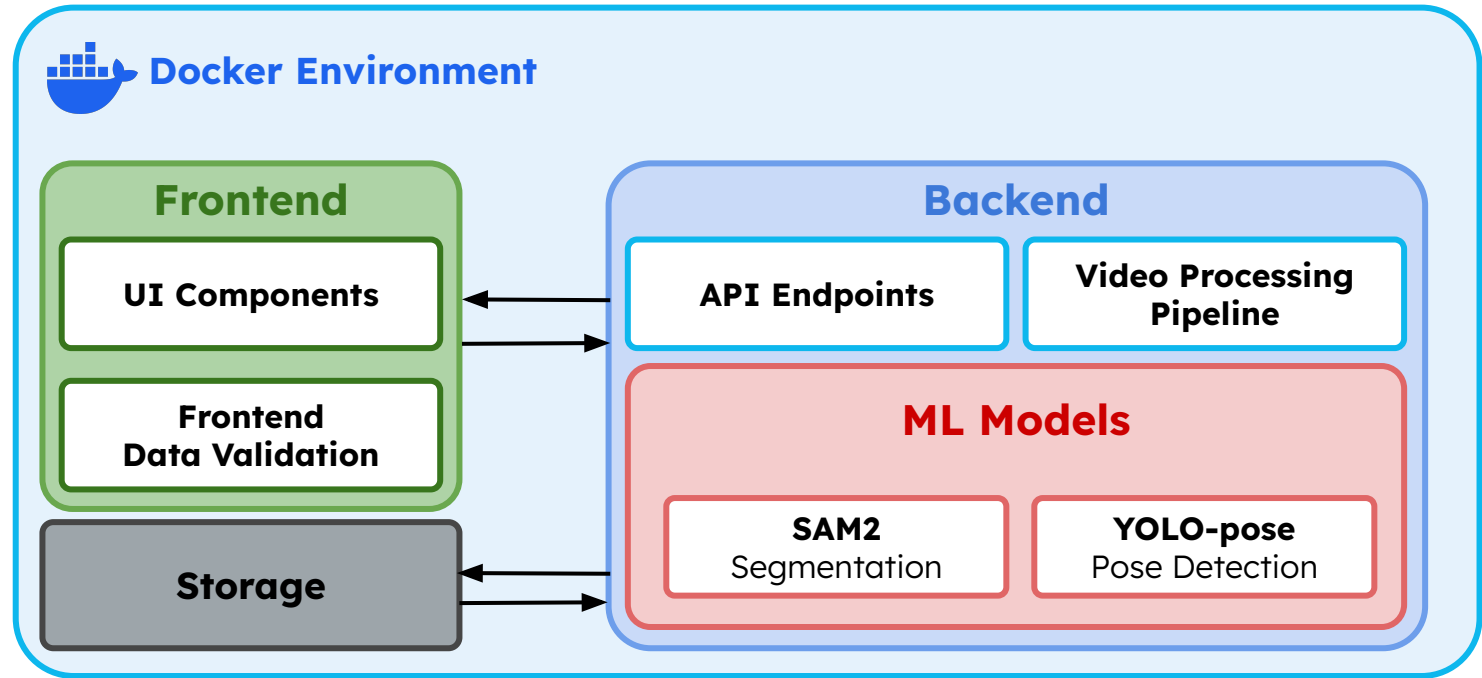
https://www.hudl.com/en_gb/products/sportscore

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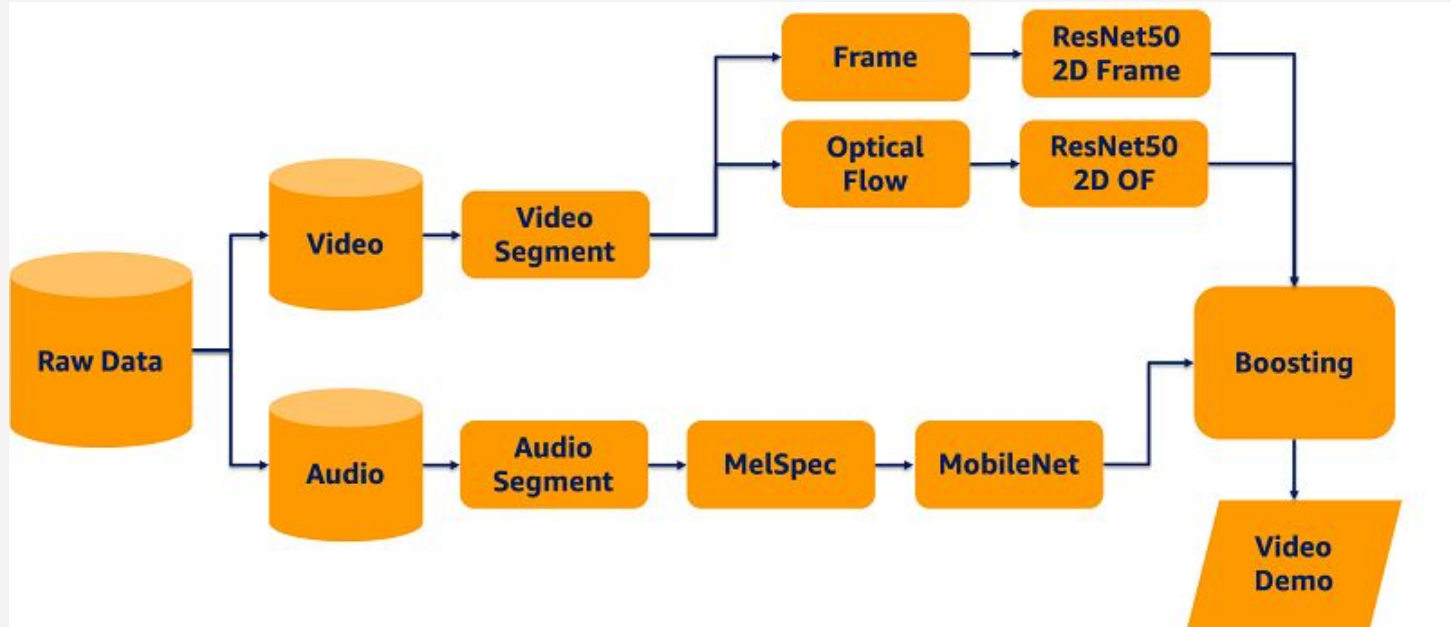
Project Architecture Overview

Frontend and Backend Architectures



Project Architecture Overview

Project Pipeline motivation

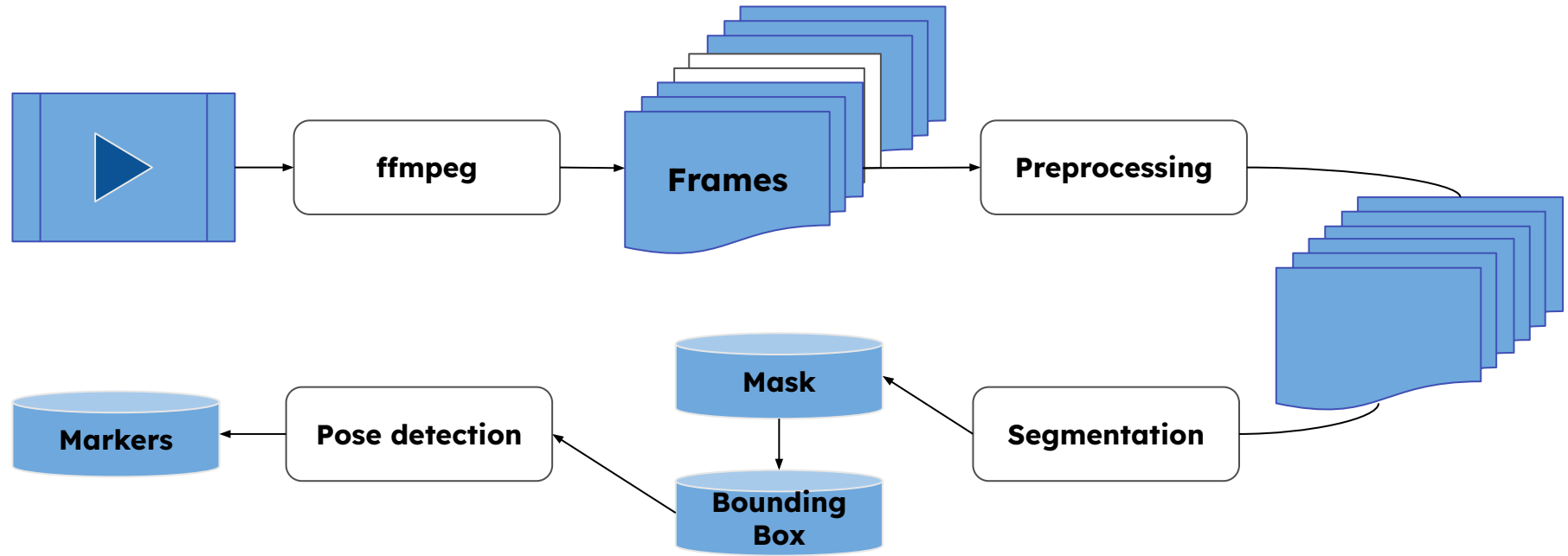


Multimodal deep learning approach for event detection in sports using Amazon SageMaker

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

Project Architecture Overview

Project Pipeline

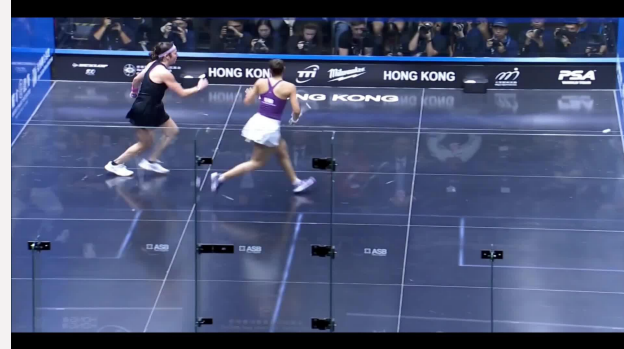


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Preprocessing process

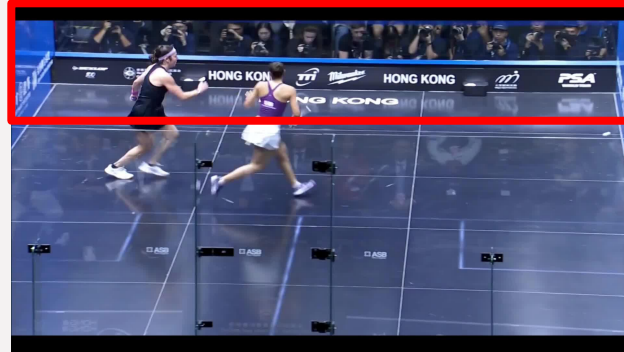
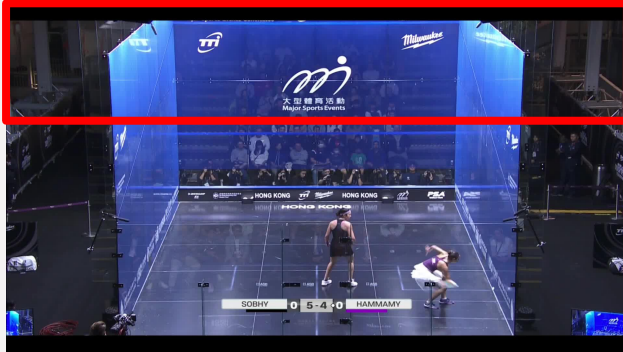
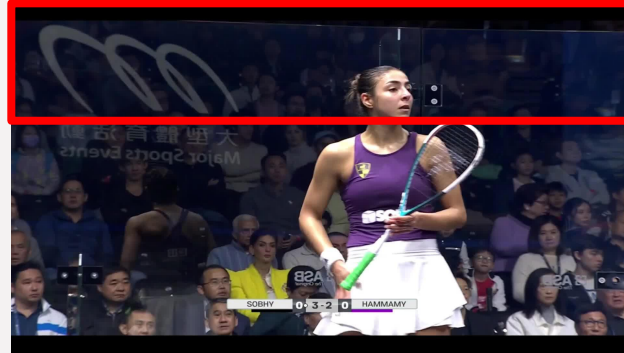
Processing overview



Examples of main angles and alternate angles

Preprocessing process

Examples



Examples of main angles and alternate angles

Preprocessing process

Frontend and Backend Architectures

Video Preprocessing
Analyze the video to detect main view angles and prepare it for player segmentation.

Recent Uploads

- 2a79c3b-5d85-46a6-8b45-63f...
4/5/2025
- f724d0e-21ae-4770-b139-38ce...
4/5/2025

View All Stages

1 Stage 1/5: Video Preprocessing
Analyze the video to detect main view angles and prepare it for player segmentation.

☐ Ready to process

Process Video

← Previous Stage 1 of 5 Next →

Main View Segments
No segments detected yet

Process the video to detect main view segments

Squash Phase Detector

Main View Segments
✓ 14 segments and 4 chunks detected

Click on a segment to jump to that position in the video

Image hash algorithms

(Python ImageHash)

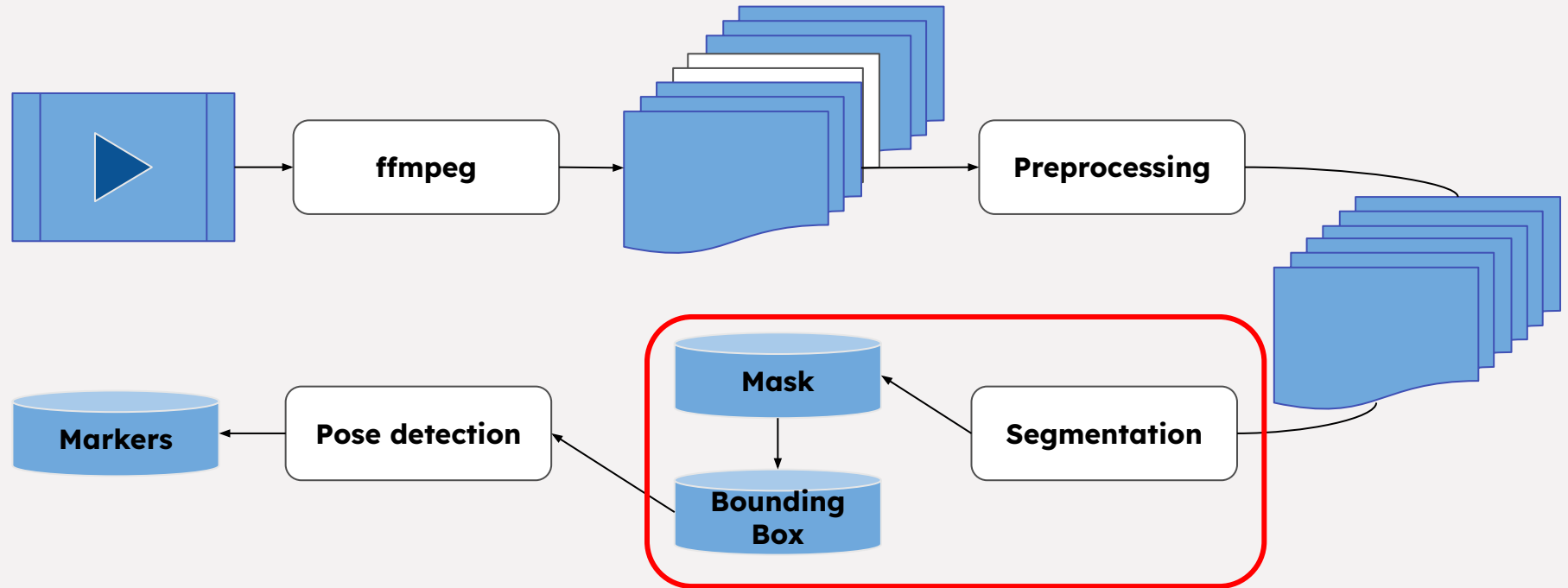
- Average hashing
- **Perceptual hashing**
- Difference hashing
- Wavelet hashing
- HSV color hashing (colorhash)
- Crop-resistant hashing

Optimization

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

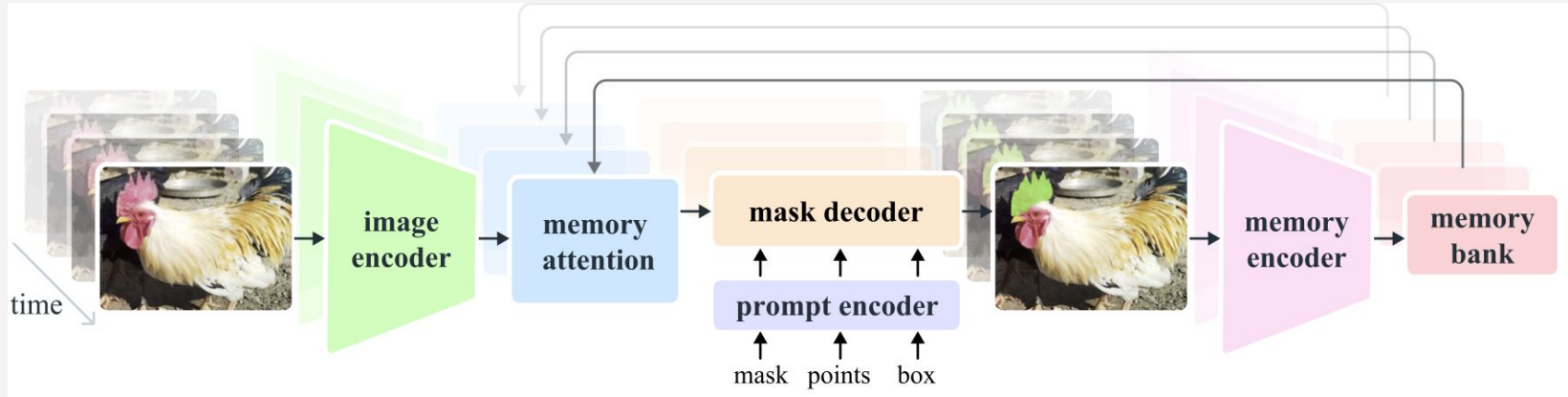
Project Architecture Overview

Project Pipeline



Segmentation process

Model Introduction



Segment Anything Model 2 (SAM 2) Architecture

<https://github.com/facebookresearch/sam2>

Segmentation process

Frontend and Backend Architectures

Player Segmentation

Mark players in the frame and generate segmentation masks for tracking.



Main View Segments



View All Stages

2 Stage 2/5: Player Segmentation

Mark players in the frame and generate segmentation masks for tracking.

☐ Ready to process

Segmentation Model

SAM2 (Recommended)

Marker Type

Add markers by clicking on the video frame. Use positive markers to include areas and negative markers to exclude areas.

+ Positive

- Negative

Player Selection

Player 1 (+2 / -1)

Player 2 (+2 / -1)

Clear Player 1

Clear Player 2

Marker Information

Frame 105

Player 1

+ Positive Points:

+ 326.5, 347.453125

+ 337.3, 393.453125

- Negative Points:

- 371.5, 339.453125

Player 2

+ Positive Points:

+ 618.5, 374.453125

+ 610.5, 413.453125

- Negative Points:

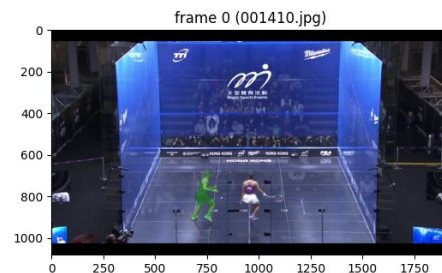
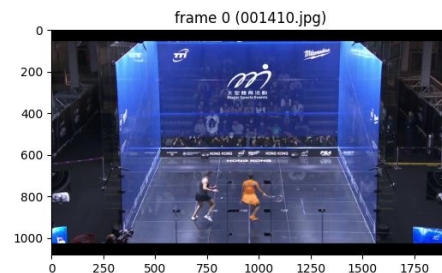
- 632.5, 356.453125

Start Segmentation

Previous

Stage 2 of 5

Next

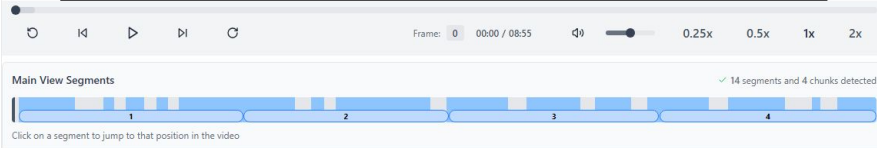


Segmentation process

Frontend and Backend Architectures

Player Segmentation

Mark players in the frame and generate segmentation masks for tracking.



View All Stages

2 Stage 2/5: Player Segmentation

Mark players in the frame and generate segmentation masks for tracking.

☐ Ready to process

Segmentation Model: SAM2 (Recommended)

Marker Type: Add markers by clicking on the video frame. Use positive markers to include areas and negative markers to exclude areas.

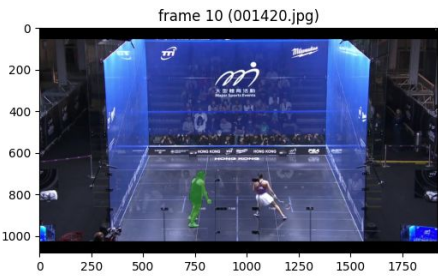
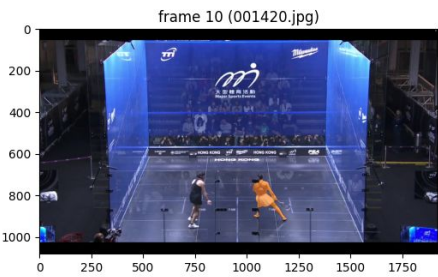
☒ Positive ☐ Negative

Player Selection: ☒ Player 1 (+0 / -0) ☐ Player 2 (+0 / -0)

Marker Information

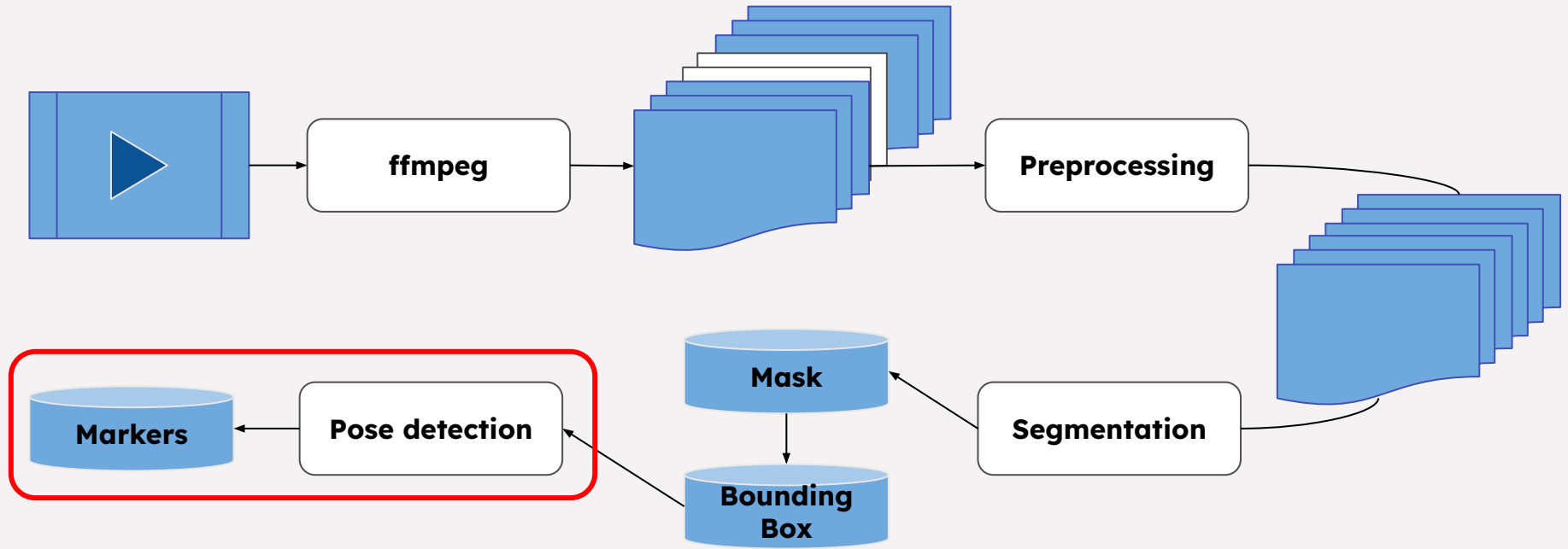
Start Segmentation

← Previous Stage 2 of 5 Next →



Project Architecture Overview

Project Pipeline

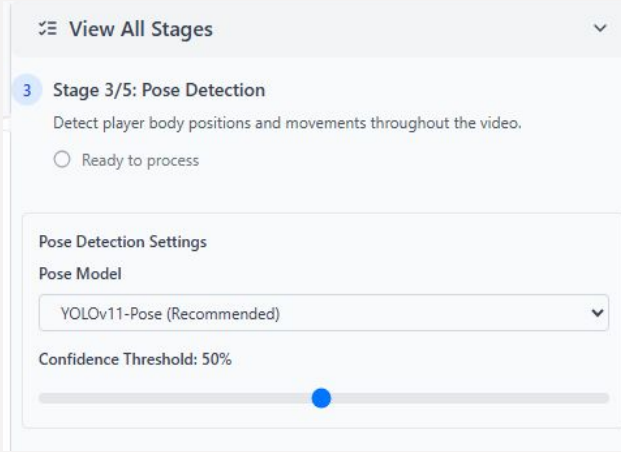
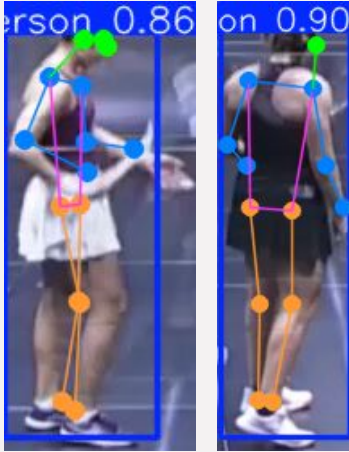


Pose detection process

Frontend and Backend Architectures



Ultralytics YOLO 11



Analysis and export stage

Frontend Interfaces

Exploratory Data Analysis (EDA)

View All Stages

4

Stage 4/5: Game State Analysis

Generate Exploratory data analysis (EDA) Report for squash game analysis

☐ Ready to process

► Generate Exploratory data analysis (EDA) Report

← Previous

Stage 4 of 5

Next →

View All Stages

5

Stage 5/5: Export Results

Export the analysis results in various formats.

☐ Ready to process

Export Options

Export your analysis results in various formats.

📄

Export Data

📄

Export Report

← Previous

Stage 5 of 5

Next →

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