POST GRADUATE INSTITUTE OF SCIENCE

UNIVERSITY OF PERADENIYA

DS 5216 - Artificial Intelligence

Programming Assignment 02

Player Tracking in Sports Videos

T. PAGALAVAN

DTS2435

# Introduction

This project focuses on developing a computer vision–based system for player detection and pose (key point) estimation in sports videos. The objective is to analyze short sports clips (5–10 seconds) and automatically detect players, track their movement, and estimate body key points using deep learning models.

Two main tasks were implemented:

- Player Detection using a YOLO-like object detection model
- Keypoint Detection (Pose Estimation) using an OpenPose-style framework

The system was evaluated on multiple sports videos, primarily cricket practice clips, football and rugby, to assess detection accuracy, robustness, and pose estimation quality.

# Dataset Description

Sports video clips were used for this assignment.

- Source: YouTube sports videos (football/cricket/rugby)
- Duration: 5–10 seconds per clip
- Scenes: Multiple players moving dynamically across the field
- Resolution: Vertical videos (portrait orientation)
- Total dates: 6 videos

Preprocessing

- Videos were converted into frames
- Frames were resized to fit the YOLO model input
- Frames were processed sequentially for detection

This dataset is suitable for demonstrating real-time player detection in realistic sports environments.

# Implementation

### Player Detection Model

For player detection, a YOLO-like object detection model was used. The model was trained to detect the class 'person' in each video frame. The output of the model consists of bounding boxes drawn around detected players along with confidence scores. Non-Maximum Suppression was applied to remove duplicate detections

### Keypoint Detection

In addition to player detection, a pose estimation model similar to OpenPose was implemented. This model detects key body joints such as the head, shoulders, elbows, hips, knees, and ankles. The detected keypoints are connected to form a skeleton structure that represents the player’s posture.

# Output Analysis

The system was evaluated on 6 short sports videos (5–10 seconds each) covering cricket practice, professional cricket matches, football and rugby training drills, and football and rugby match scenarios. Both player detection and keypoint detection outputs were generated for these videos.

### Player Detection Results

The output results show that the player detection model performs well across all six videos. In cricket, rugby and football videos, the model successfully detected batsmen, bowlers, umpires, and fielders at the same time. In football videos, multiple players were detected even in crowded match situations same ass rugby videos. The confidence scores generally ranged from 0.5 to 0.9, with higher confidence for players who were closer to the camera.

### Keypoint Detection Results

The keypoint detection results were visually accurate for most frames. The model captured important body movements such as bowling actions in cricket and passing movements in football and rugby drills. While minor inaccuracies were observed during fast motion or partial occlusion, the overall pose estimation remained consistent and meaningful.

## Performance Discussion

Overall, the player detection model demonstrated good accuracy and stability across different sports and environments. The pose estimation model provided useful insights into player movement and posture. However, the system showed limitations when players were far from the camera or partially occluded by other objects.

## Limitations and Improvements

The main limitations of the system include occasional missed detections during fast motion and reduced accuracy for distant players. The dataset size was also limited to six short videos. Future improvements could include training on a larger and more diverse dataset, adding player tracking algorithms to maintain player identities across frames, and improving pose estimation accuracy using temporal smoothing techniques.

## Conclusion

This project successfully demonstrates the application of deep learning techniques for player detection and keypoint estimation in sports videos. The system works effectively across multiple sports and video conditions. With further improvements, this approach can be extended to advanced sports analytics and performance analysis applications.