**Camera-based Basketball Video Analysis through Deep Learning Techniques**

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Project Proposal:

Our project will focus on the analysis of basketball games with the aim of detecting some metrics of interest. Many statistics can be extracted from a basketball match, like the most basic ones such as players’ points/assists/fouls, but also some more sophisticated features about the games such as ball possession percentages, shooting percentages or even the distances traveled by each player.

We believe that our work is going to be an interesting and innovative project because it would allow us to automate many activities that are currently carried out manually, therefore they require a great effort in terms of time and costs.

The project will involve two main DL techniques: Object Detection and Multiple Object Tracking. The former one will be employed to detect the ball, the sidelines and the rim. The latter one instead will be used to detect and to distinguish the players on the court in order to attribute every statistic to the correct one. We’ll also leverage geometric techniques, like homographies with fish eye cameras, in order to have a perspective of the court.

We’ll employ training to fine tune well-known MOT networks to work at best on recognizing the players of each corresponding team, as well as the basketball, the rim and the sidelines of the field with object detection networks like YOLO or mask-RCNN.

We found various datasets in literature to train the networks, for example the DeepSort dataset-v1 and the NSVA(NBA dataset for Sports Video Analysis), and others specific dataset to recognize single objects such as the rim and the ball.

It might be needed to collect some more data by labeling some basketball games video of the games of one of us if the performances don't look sufficiently good. To estimate the performances we’ll firstly focus on the correctness of the networks to identify the objects in the videos using the typical metrics for MOT and object detection such as MOTA, average precision or F1-score. And then the final goal will be to compare the accuracy of the output statistics to our reference baseline, which is simply the human.

On the next page a list of some of the references we’ll base our work on.

A comprehensive overview of artificial intelligence applications in basketball

<https://efsupit.ro/images/stories/ianuarie2024/Art6.pdf>

Fine-grained Video Captioning for Sports Narrative

<https://openaccess.thecvf.com/content_cvpr_2018/CameraReady/0668.pdf>

NBA dataset for Sports Video Analysis (NSVA)

<https://github.com/jackwu502/nsva>

Sports Video Analysis on Large-Scale Data

<https://arxiv.org/pdf/2208.04897>

Deep Sport radar challenge

<https://github.com/DeepSportradar>

DeepSportradar-v1: Computer Vision Dataset for Sports Understanding with High Quality Annotations:<https://arxiv.org/pdf/2208.08190v1>

Kaggle:<https://www.kaggle.com/datasets/gabrielvanzandycke/deepsport-dataset?resource=download>

Real-time CNN-based Segmentation Architecture for Ball Detection in a Single View Setup:<https://arxiv.org/pdf/2007.11876v1>

Masked R-CNN implementation:

<https://github.com/matterport/Mask_RCNN>

<https://github.com/MatteoDalponte/Basketball_statistics?tab=readme-ov-file>

Computer vision for detecting and tracking players in basketball videos:

<https://webthesis.biblio.polito.it/15863/1/tesi.pdf>

A Fast Deep Learning Based Approach for BasketballVideo Analysis:

<https://dl.acm.org/doi/pdf/10.1145/3448823.3448882>

Camera-based Basketball Scoring Detection Using Convolutional Neural Network

<https://www.mi-research.net/article/doi/10.1007/s11633-020-1259-7>

<https://github.com/simonefrancia/SpaceJam?tab=readme-ov-file>

Dataset for ball recognition

<https://universe.roboflow.com/eagle-eye/basketball-1zhpe>

Shoot detection model

<https://github.com/avishah3/AI-Basketball-Shot-Detection-Tracker>