*Support for Skill Acquisition in Youth Basketball*

## Context

Young players training is often devoted to undersized staff within organisations such as associations mostly composed of volunteers in France for youth basketball. It frequently happens to have 1 single trainer for 10 to 16 players in a training session. Moreover, most of the teams don’t train more than twice a week. Therefore, skill acquisition ought to be efficient! Whereas trainer education remains the key factor for better training, new technologies based on Computer Vision and Machine Learning could be of great support in such a process. This project aims at providing youth basketball trainers real-time video analysis toolings in order to improve skill acquisition, its outcomes, its duration, etc.

## Objectives

The preliminary work ot this project consists in investigating the best camera settings according to several analysis features. It will then provide the prerequisite tooling for addressing the overall goal. In fact, it also consists in developing both video acquisition systems and analysis feature processings in order to assess which is the best one according to the evaluation criterion below.

### Tasks

This work then consists of:

developing the video acquisition systems that correspond to the camera settings
developing the video processings that correspond to the analysis features
carrying out experiments that lead to find out the best setting
writing scientific papers that detail this work

### Evaluation Criterion

The criterion for camera setting evaluation are:

video acquisition hardware cost (in €)
video acquisition software cost (in lines-of-code)
video acquisition system performance (in seconds)
analysis feature software processing cost (in lines-of-code)
analysis feature processing performance (in seconds)
analysis feature processing accuracy (in Precision, Recall and F-Measure)

### Camera Settings

The targeted camera settings are:

1 camera with motion tracking
2 cameras with image selection
2-as-1 cameras with image merging

### Analysis Features

The targeted analysis feature are:

court detection: detect the basketball court in an image
player detection: detect the players in an image
player tracking: track the players through successive images
team detection: gather players into teams in an image
play detection: cut a video sequence into subsequences that correspond to actions
play classification: predict the type of play for each player in a video sequence

## Technologies

The targeted technologies are:

OpenCV for both Computer Vision and Deep Learning (https://opencv.org/)
Java as programming language

# Roadmap

## Tasks

State-of-the-Art
reading the different articles about machine-learning based sport analysis
Reading
collecting and analysing articles
Writing
summing up all readings
Dataset
building a dataset of youth basketball videos
Initial
building a first dataset for prototyping the analysis components
Intermediate
building a common dataset with the different video acquisition systems
Final
releasing publicly the dataset that will support the experiments
Cameras
developing video acquisition systems with camera settings
1 camera system with motion detection processing
2 cameras with image selection processing
2-as-1 cameras with image merging processing
Analysis
developing video processing components for the analysis features

## Milestones

# References


Colby T. Jeffries. “Sports Analytics With Computer Vision”. Senior Independent Study Theses. Paper 8103, 2018.
Graham Thomas, Rikke Gade, Thomas Moeslund, Peter Car, Adrian Hilton. “Computer Vision for Sports: Current Applications and Research Topics”. Computer Vision and Image Understanding. 159. 2017.
Wei-Lwun. Lu, Jo-Anne Ting, James J. Little and Kevin. P. Murphy, “Learning to Track and Identify Players from Broadcast Sports Videos,” in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 35, no. 7, pp. 1704-1716, July 2013.
Adrià Arbués-Sangüesa, Coloma Ballester, Gloria Haro. “Single-Camera Basketball Tracker through Pose and Semantic Feature Fusion”. 2019.
Francia, Simone, Simone Calderara, Dott Fabio Lanzi. “Classificazione di Azioni Cestistiche mediante Tecniche di Deep Learning.” 2018.
Arda Senocak, Tae-Hyun Oh, Junsik Kim and In So Kweon, “Part-Based Player Identification Using Deep Convolutional Representation and Multi-scale Pooling,” 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops. pp. 1813-18137, 2018.
Evan Cheshire, Cibele Halasz, Jose Krause Perin. “Player Tracking and Analysis of Basketball Plays”
Pei-Chih Wen, Wei-Chih Cheng, Yu-Shuen Wang, Hung-Kuo Chu, Nick C. Tang, and Hong-Yuan Mark Liao. “Court Reconstruction for Camera Calibration in Broadcast Basketball Videos,” in IEEE Transactions on Visualization and Computer Graphics, vol. 22, no. 5, pp. 1517-1526, 2016.
P. K. Santhosh, B. Kaarthick. “An Automated Player Detection and Tracking in Basketball Game”. Materials & Continua. 58. pp. 625-639. 2019.
Chen, Jianhui, Fangrui Zhu, and James J. Little. “A two-point method for PTZ camera calibration in sports.” 2018 IEEE Winter Conference on Applications of Computer Vision. IEEE, 2018.
Vignesh Ramanathan , Jonathan Huang , Sami Abu-El-Haija , Alexander Gorban, Kevin Murphy , and Li Fei-Fei. “Detecting Events and Key Actors in Multi-person Videos,” 2016 IEEE Conference on Computer Vision and Pattern Recognition, pp. 3043-3053, 2016.
Joseph Redmon, Santosh Divvala, Ross Girshick, Ali Farhadi. “You Only Look Once: Unified, Real-Time Object Detection”. in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 779-788). 2016.