Automatic Tennis Game Play Analyzer
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Introduction and Goals
- There has always been a great interest in analyzing sport matches. Trainers and players always look for the training plans and game strategies, in order to improve their game.
- Current methods include watching video clips and deriving course manual statistics.
- There are automatic analysis systems (e.g., Hawkeye), but they are very expensive and not available to the general public.
- The project goal was to create an automatic model for processing and analyzing official tennis matches, using computer vision tools capable of running on standard computers.

Court Detection and Tracking
Court detection is done on the first frame using various computer vision algorithms:
- Hough transform for finding straight lines.
- Finding corresponding points between the court in the frame and a reference court model.
- Calculating projective transformation between the court in the frame and the reference court.

Players Detection and Tracking
- Done for each player separately, after detecting the court in the frame.
- Each player is searched in a new ROI based on possible location in the court.
- Done by the fasterRCNN deep convolution network, trained on ImageNet to detect people.
- Tracking is done using the SORT algorithm, which predicts the player's next position and compares to the detected one.

Data Sets
Two training data sets are used:
- TrackNet Dataset: contains 20K frames from official tennis matches. The ball position is tagged in each frame.
- Strokes Dataset: self-built 30-minute set of 1400 1-2 seconds video clips of strokes performed by various players. Strokes are tagged as forehand, backhand, service/slash.

Stroke Detection and Classification
- Stroke Moment is detected using the known players and ball positions, by finding the frames where the ball changes its movement direction near a player.
- Stroke Type is classified using the deep network shown in the diagram.

Statistics Generation
- Statistics are generated during the post-processing phase, using the information collected earlier.
- Using the inverse transformation of the court position, the players positions are projected onto the reference court model.
- This enable calculation of numerous statistics, such as total running distance per player and heat map of the player positions.
- Stroke type statistics are also collected.

Gameplay Top View Generation
The top view is generated by using the players and ball positions on the reference court model.

Results and Conclusions
- The project created an end-to-end model, based on computer vision tools and algorithm, capable of processing and analyzing tennis matches, including real-time processing.

Future Developments
- Automatic Referee: identifying whether the ball landed inside or outside the court.
- Speeding up the calculations and real-time processing.
- Predicting future strokes.

Innovations
- First open tool that can process and analyze tennis matches using low-cost equipment, a single camera and low-quality video.
- A personal tool that enables a player or a trainer to do detailed analysis of matches.

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