Automated Exercise Trainer and Game Statistics Application

Category: Health & Wellness

My Vision

- Sports Automation.
- Decentralize high-precision world class coaching
- Providing deep insights using Machine Learning.
- Removing Sensors and high precision cameras.

What am I building?

- Sports Technique Analysis.
- Automated Exercise Trainer.
- Fitness Application.
- Injury Prevention.
- Game Statistics.

Tools and Technology

- A decent phone camera and my App.

Exercise Trainer

- Detection of human pose.
- Classifying different type of exercises.
- Providing automatic feedback and score to the user.
- Correcting the posture.

Pose Estimation

- Python.
- Openpose Library. (For Pose Estimation)
- Pose-Trainer Library.
- Pose-hg-3d. (For Pose Estimation)
- Detectron. (For Pose-Estimation)
- DTW Algorithm. (Dynamic Time Warping)
- Caffe (Deep Learning Framework)

Classification and Correction of Exercise

- Classifying different exercises.
- Giving good and bad scores to exercises.
- Scoring performance of each exercise out of 10.
- Classification of each exercise into good and bad exercise.
- Providing proper feedback/correction for each exercise if any exercise is being performed incorrectly.
- Correction of posture.

Classification and Correction of Exercise

- Calculation of different body angles.
- Exercise arm detection.
- Calculation of Rep Counts in PushUps.
- Similarly, calculation of pose hold percentage in Plank and WallChair exercise.

Implementation in Android Studio

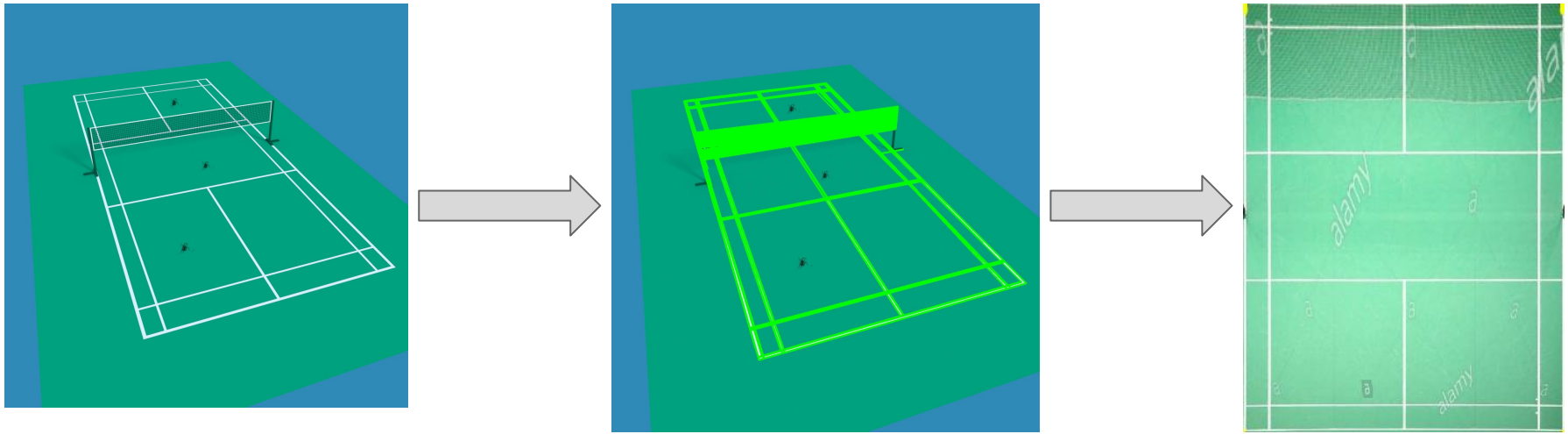
- Chaquopy Library.
- It is the Python SDK for Android.
- The easiest way to use Python in your Android app.
- Chaquopy enables you to freely intermix Python, Java and Kotlin in any app.
- Using Chaquopy library for implementing Python code in Android Studio.

Game Statistics

- Court/ground mapping.
- Object Tracking.
- Trajectory of Object.
- Speed & Angle of Object.
- Player Position.

Court Mapping

- Perspective transform - Homography transform.



Object Tracking

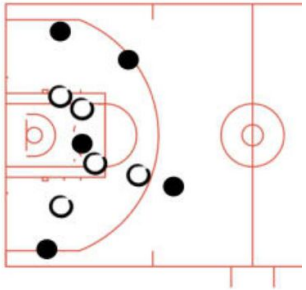
- **Object Detection** - Using YOLOv3.
- **Object Tracking** - Using OpenCV object trackers.
    - "csrt": cv2.TrackerCSRT_create,
    - "kcf": cv2.TrackerKCF_create,
    - "boosting": cv2.TrackerBoosting_create,
    - "mil": cv2.TrackerMIL_create,
    - "tld": cv2.TrackerTLD_create,
    - "medianflow": cv2.TrackerMedianFlow_create,
    - "mosse": cv2.TrackerMOSSE_create

Trajectory and Speed Analysis

- Get trajectory using centroid of tracked object.
- Record the coordinates.
- Compute parameters like speed, angle.
- Using Depth Estimation.

Player Position

- Track player position.
- Map 3D points on a 2D court using perspective transform.



Sports Technique Analysis

- Automated sports technique analysis in badminton.
- Analyzing movements and providing analysis.
- Use of computer vision and deep learning techniques.
- Provide deep insights on technique improvement in real time.

Data preparation

- Using time, speed and technique as parameters for formation.
- Forming the dataset containing good and bad videos.
- Forming knowledge base for the model.
- Conversion of video data into numpy array format.

Classification of Technique

- Pose estimation to visualize keypoints.
- Classification of technique into its type.
- Keypoints extraction through openpose and pose estimation.
- Extracting angles out of keypoints and forming training set of angles.
- Using dynamic time warping(DTW) algorithm.
- DTW: normalization and comparison of test video with training set.

Tools and Technologies

- Python
- OpenPose library
- Pose-Trainer library
- Caffe framework

Injury Prevention

- Capturing the movement through multiple cameras.
- Estimating 2D pose estimation for each view.
- 3D reconstructing combining multiple views.
- Extracting Angles and coordinates of each point.
- Providing feedback and injury chances.
- Correcting the posture to avoid injuries.