Developing the concept of Postural Ageing by linking it to Biological Ageing

A dataset of 23 subjects was collected for this purpose. Each subject was recorded in various poses known to reflect age-differences: standing-still; standing on one leg; standing with feet-together stance; squatting consecutively for 30 seconds. The subjects were recorded using 3 RealSense depth cameras and Vicon motion capture system, which captures the 3d coordinates of markers on anatomical landmarks.

**Task 1: Predicting chronological ageing from postural data**

A dataset of ~250,000 samples was created using the Vicon motion capture system. Each sample consists of a pair of 39 3d points and a binary label. The 39 points represent a subject in a one of the poses described above. The binary label is either “old” or “young”, based on the subject’s age. In order to predict the label of each person we have used PointNet: a supervised network architecture for classifying point clouds.

**Task 2: Estimating 3d skeleton from RGB-D images.**

Place holder

For the recording of the subjects, a setup of 3 RealSense cameras and Vicon motion capture system was used. The main challenges we had to deal with using this recording setup were:

1. Synchronizing the recordings – Making sure the frames from the different RealSense cameras and the Vicon system are aligned in time.
2. Calibrating the sensors – Finding the transformation between the Vicon coordinate system and the RealSense camera coordinate system.

Synchronizing the recordings: Using multiple sensors raise the challenge of aligning the different sensors’ frames in time. At the beginning of each recording session, the subject is performing T-pose for several seconds. This T-pose is later detected in the frames of the different sensors and used as the first frame. We have tried to implement automatic detection of the T-pose using OpenPose, but it did not perform well on non-frontal frames. Moreover, due to frame-drop in the RealSense cameras, manual corrections were often required after the automatic detection. The T-pose was eventually detected manually in the different recordings.

Calibrating the sensors: Since OpenPose is designed for extracting 2d pose from RGB images, calibration between the Vicon system and the RealSense cameras is required in order to project the Vicon 3d points into the RealSense images. The Vicon system, which consists of X separate sensors, is calibrated by using a calibration wand. The algorithm for this inter-calibration is already implemented in the Vicon system. Our challenge was to calibrate each RealSense camera with the Vicon system. We have used Kabsch’s algorithm in order to find the transformation between the Vicon coordinate system and the RealSense camera coordinate system: given 2 sets of N paired points in D dimensions, Kabsch’s algorithm calculates the rotation matrix that minimizes the RMSD between the two sets, using singular value decomposition (SVD). The calibration is done using a single frame from the RealSense camera and the corresponding frame from the Vicon system. Several improvements were made to the data before applying Kabsch’s algorithm on it: Removing points with noisy depth value, averaging the depth value of each point with neighboring pixels, sampling sub-group of the points with lowest projection error. After applying the improvements, the current projection error rate is 60mm (RMSE).

A picture containing indoor

Description automatically generatedA picture containing indoor

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Projecting the Vicon points, after applying on them the transformation calculated with Kabsch’s algorithm without improvements (Left) and with improvements (Right). The red points are “ground truth”, the green points are the projected points.