Person Re-identification with Kinect2 Sensor

Person re-identification plays an important role in video surveillance, long-term activity monitoring, and activity tracking. The fundamental task is to identify an individual at different locations and in different environments. Various features, such as facial feature, appearance feature and skeleton feature can be used to identify an individual.

In paper [1], a skeleton-based approach is proposed for person re-identification. There are in total 7 skeleton-based features:
d_1: Euclidean distance between floor and head.
d_2: Ratio between torso and legs.
d_3: Height estimate.
d_4: Euclidean distance between floor and neck.
d_5: Euclidean distance between neck and left shoulder.
d_6: Euclidean distance between neck and right shoulder.
d_7: Euclidean distance between torso center and right shoulder.

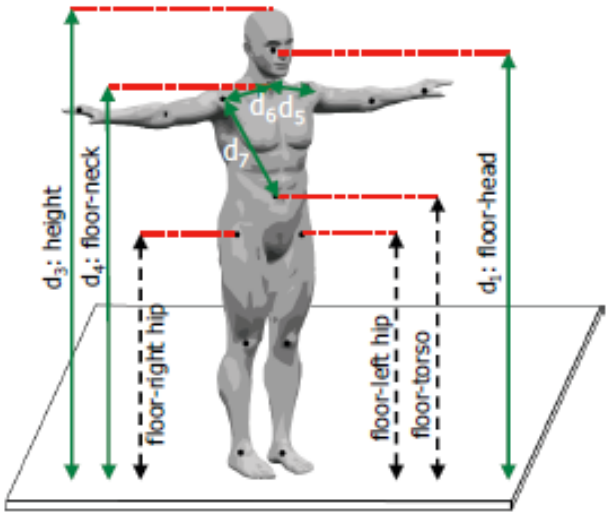

Figure1: The illustration of skeleton-based features (in green) [1].

The Microsoft Kinect2 sensors and software development tool kit (SDK) provide the 3D skeleton data of a human body and floor plane parameters, from which the aforementioned 7 skeleton-based features can be calculated. From the experiment in paper [1], the most informative cues to identify an individual are d_1 and d_2. Therefore, we use skeleton feature d_1 and d_2 to identify a person.

For the Salig++ project, we are focusing on monitoring elderly who lives alone at home. When there are multiple persons present at home, it is not necessary to monitor elderly's activity any more. Under this circumstance, the person re-identification system is designed to identify a single person. However, the system can be extended to identify multiple persons.

The person re-identification system is composed of two parts:

1. Initialization part.
We calculate the skeleton feature, d_1 and d_2, of the person that we are going to track. The initialization only starts when the person's full body skeleton is being tracked by Kinect2 sensor. We calculate the d_1 and d_2 for N consecutive frames and use the averaged value of d_1 and d_2 over the N consecutive frames as the skeleton feature to identify the person.

2. Person re-identification part.
If the tracked persons is out of Kinect view and later on a person re-enters the view, the person re-identification part starts. The skeleton feature, d_1 and d_2, of the re-entered person is calculated and compared with the value of d_1 and d_2 from the initialization step. If the difference of the value is smaller than a predefined threshold, it is determined that the re-entered person is the same person as we tracked before. Otherwise, the re-entered person is a different person.

The person re-identification system is implemented with Kinect2 under windows 8.1. The required softwares are Microsoft Visual Studio Express 2012 for Windows Desktop [2], Kinect SDK v2.0 [3] and OpenCV 2.4.8 [4].

Reference:
[1] B. Barbosa, M. Cristani, A. D. Bue, L. Bazzani, and V. Murino. “Re-identication with RGB-D sensors”, *First International Workshop on Re-Identification*, 2012, October.

[2] http://www.microsoft.com/en-us/download/details.aspx?id=34673

[3] http://www.microsoft.com/en-us/download/details.aspx?id=43661

[4] http://opencv.org/opencv-2-4-8.html