

Pedestrian tracking

VUT FIT POVa

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Task Inspiration

- Marauder's Map from Harry Potter
 - Magic parchment that reveals the current location of anyone on Hogwarts grounds



http://harrypotter.wikia.com/wiki/Marauder%27s_Map

Task definition

1. Multiple people walking in a scene
2. Multiple stationary cameras
 - ✓ Initial calibration
3. Individual path tracking

Processing pipeline

Front camera

Side camera

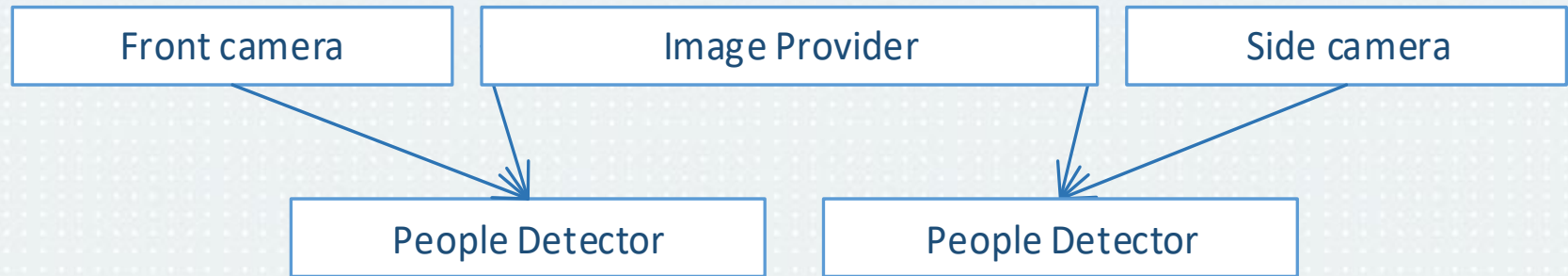
Processing pipeline

Front camera

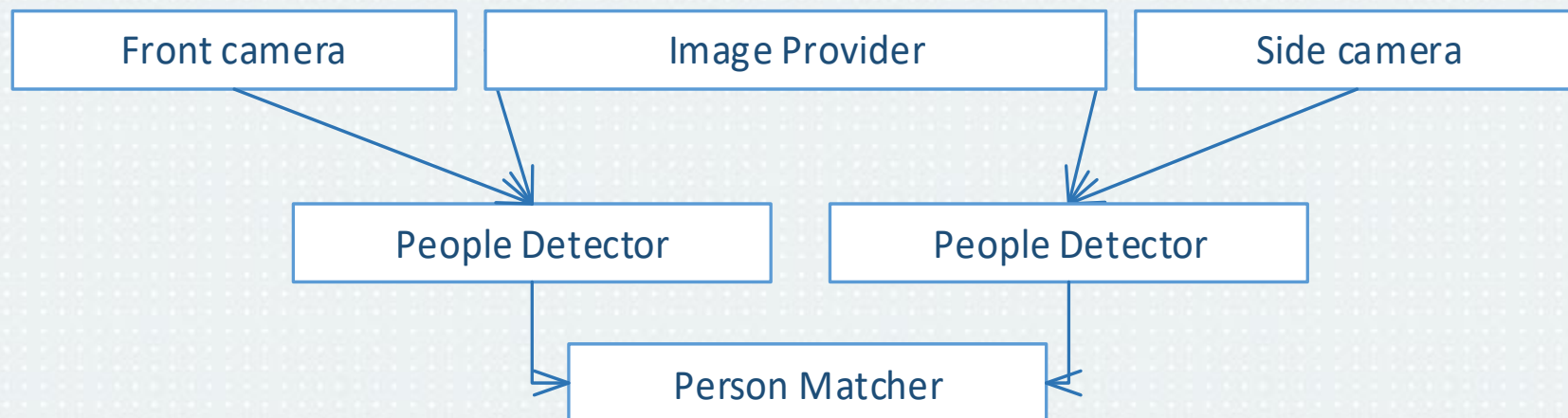
Image Provider

Side camera

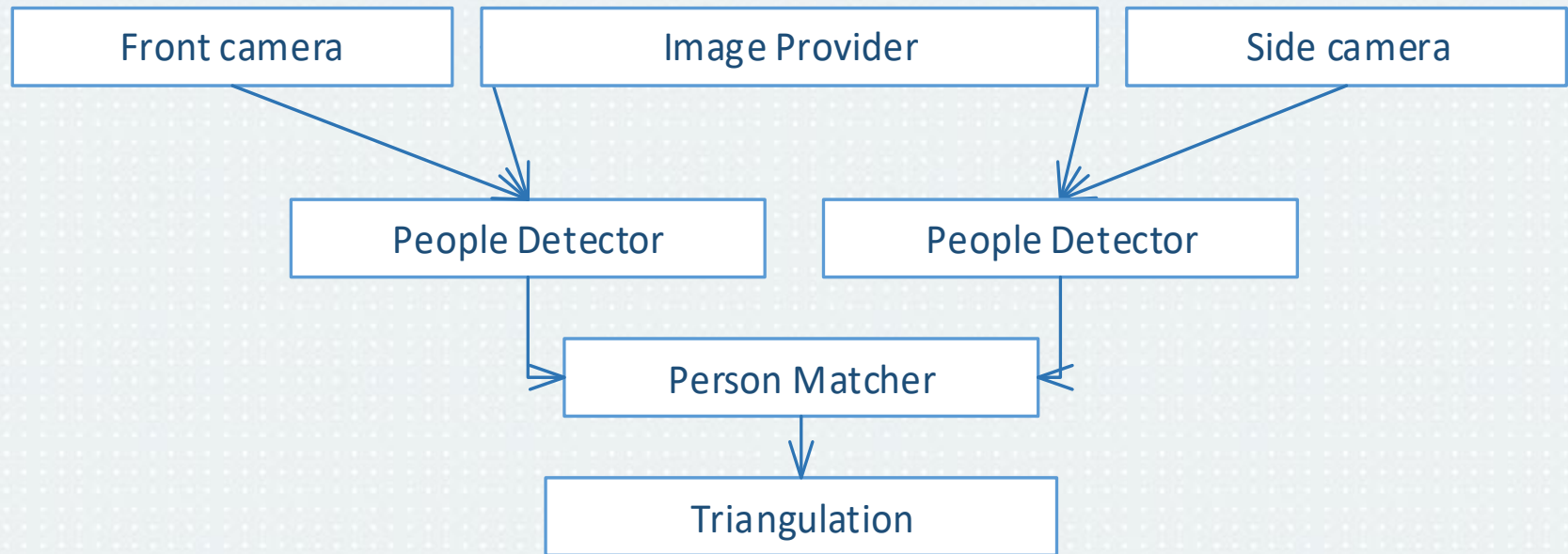
Processing pipeline



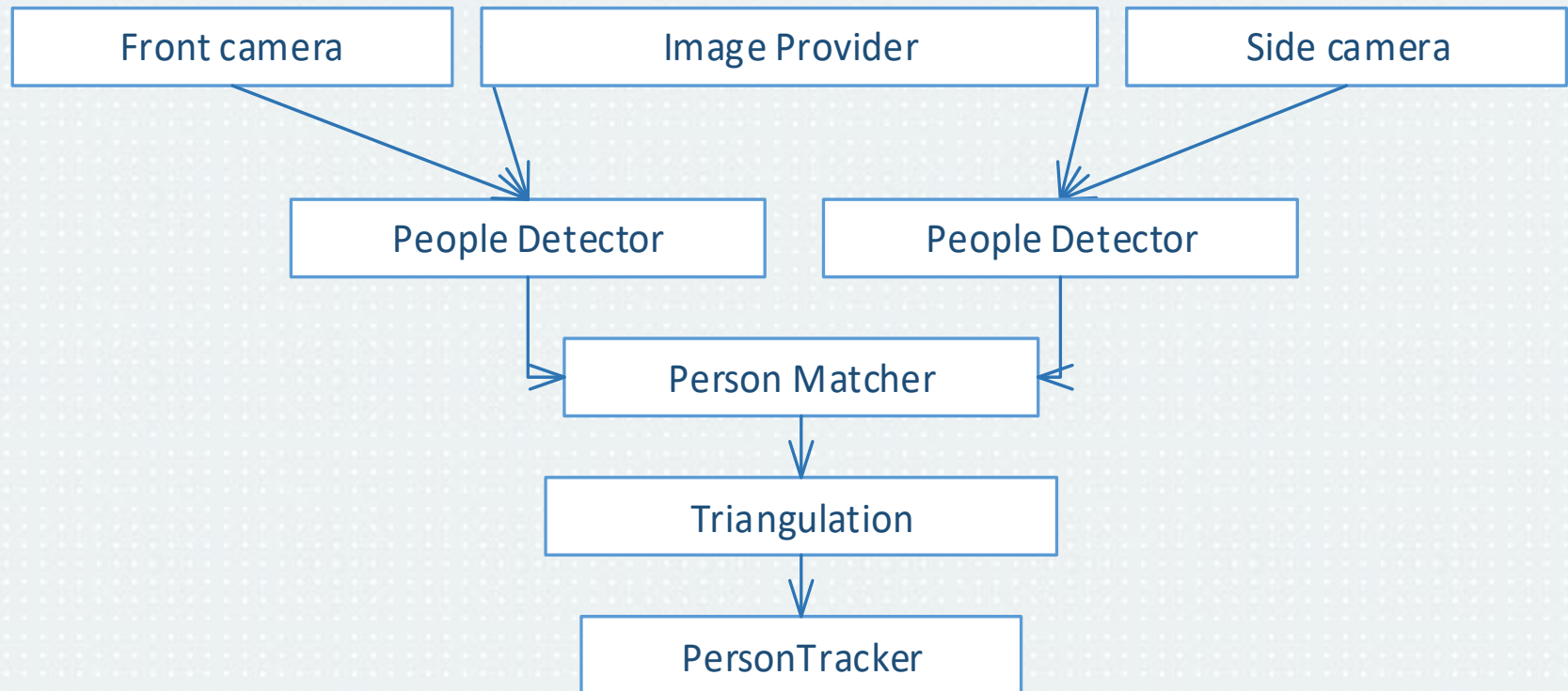
Processing pipeline



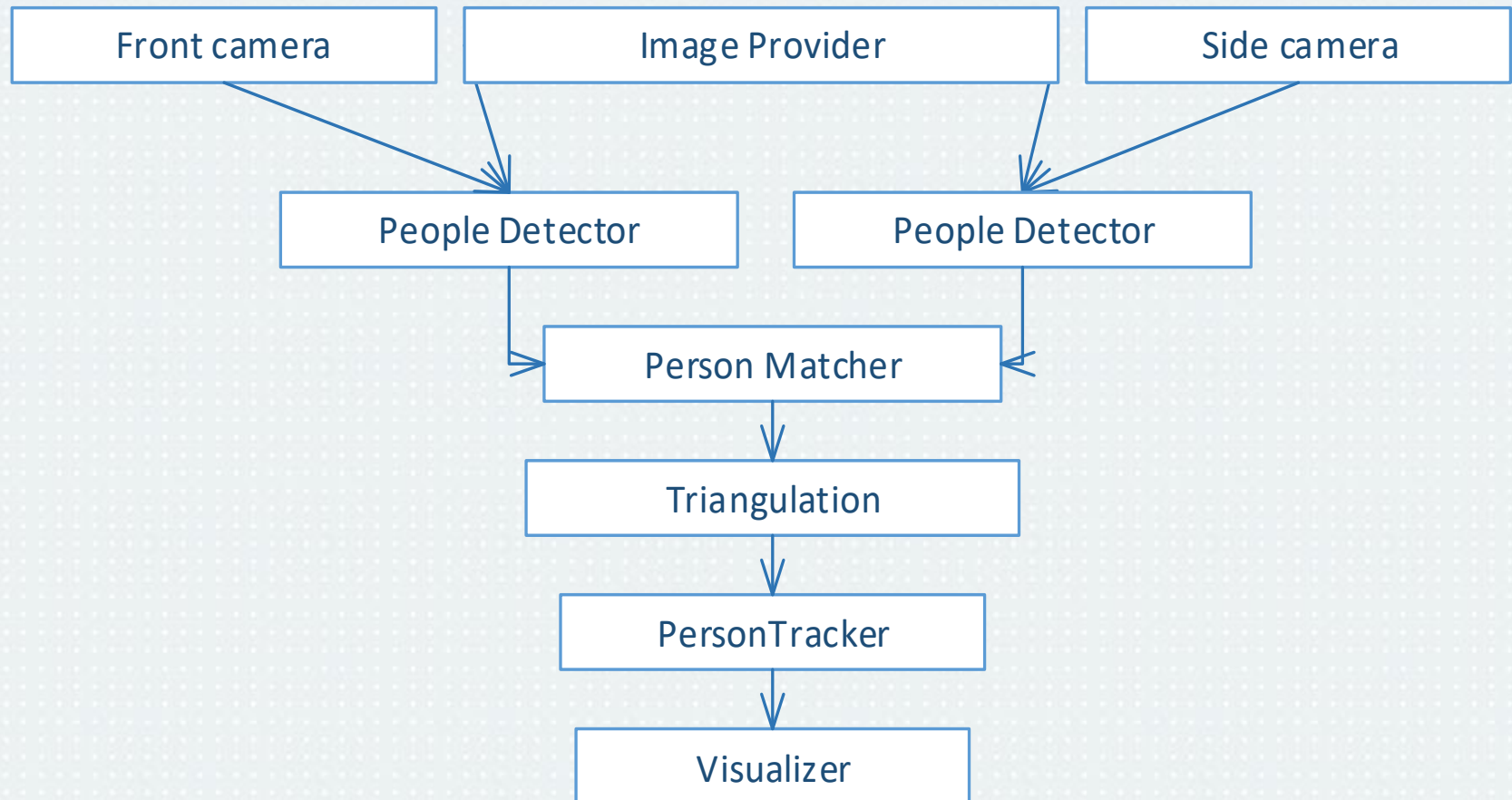
Processing pipeline



Processing pipeline

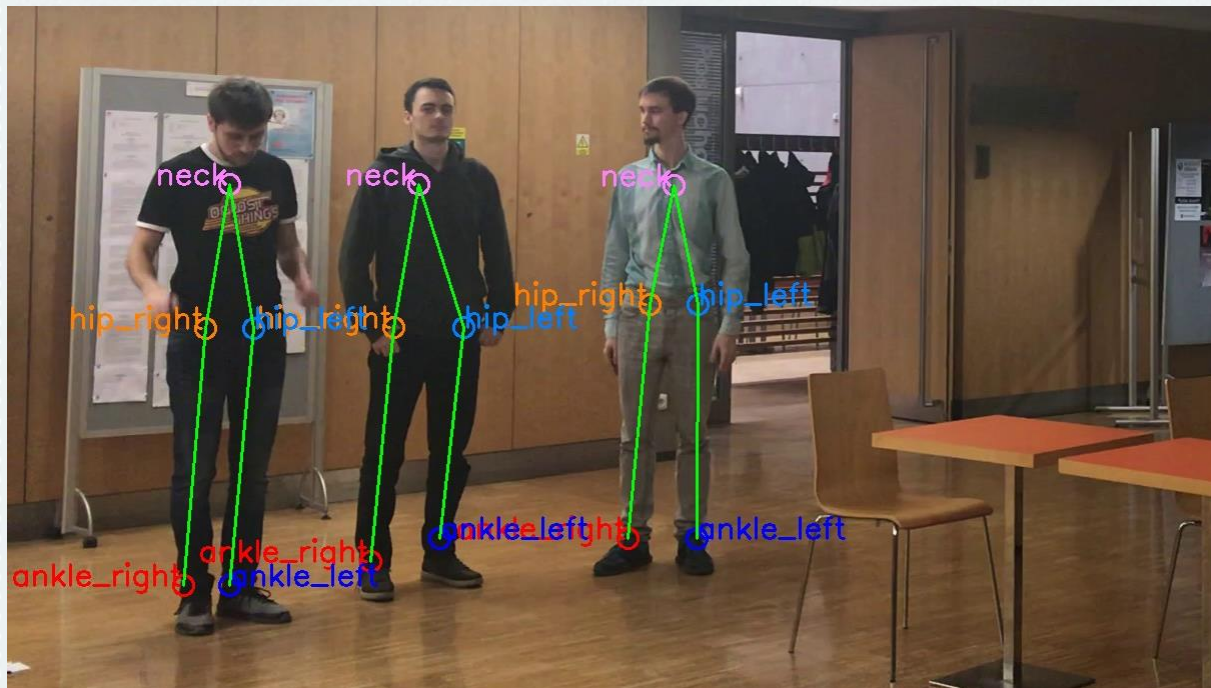


Processing pipeline



Human Detection in 2D

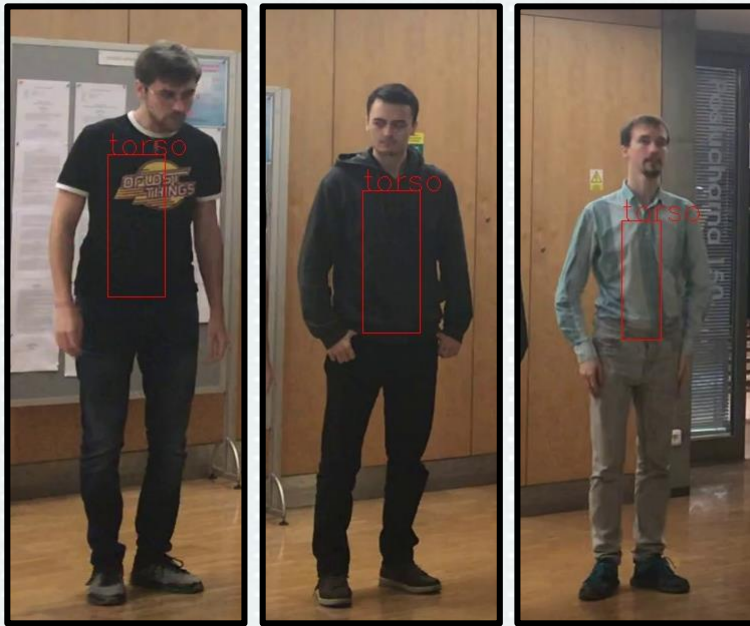
- *OpenPose* deep neural network
- Pretrained model with *COCO* dataset



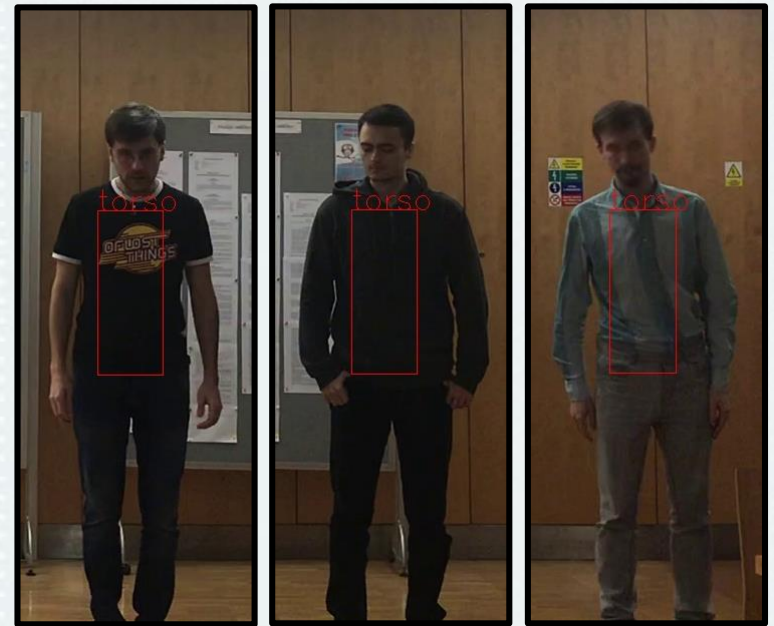
Multi-person key point detection

Person View Matching

Similar torso histograms \rightarrow same person



Side person views



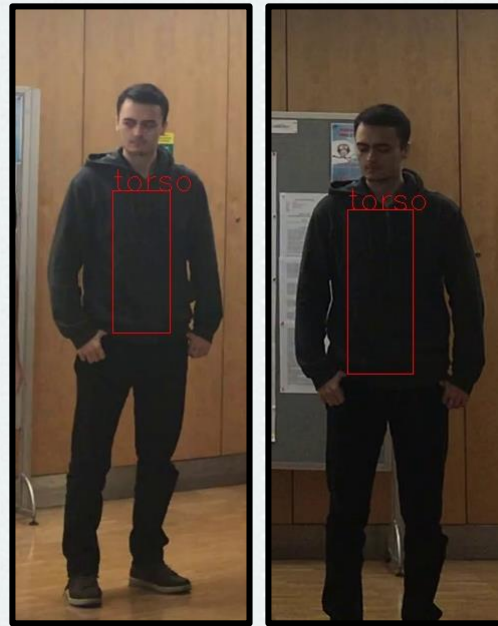
Front person views

Person View Matching

Similar torso histograms \rightarrow same person



PersonTimeFrame A



PersonTimeFrame B



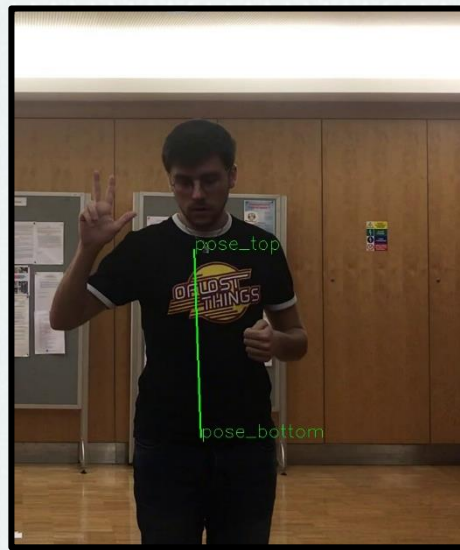
PersonTimeFrame C

Triangulation

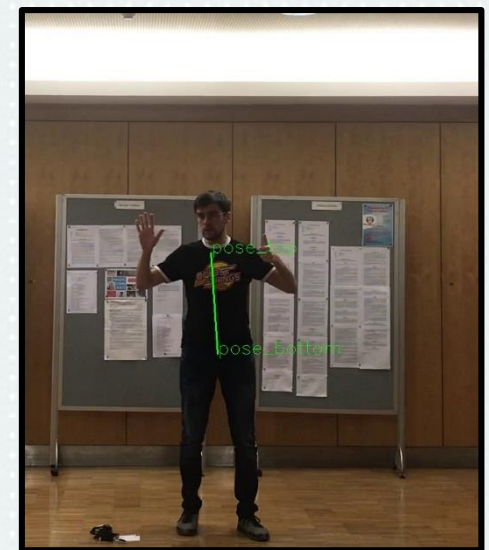
Average person's torso \rightarrow distance from camera



$y = 2 \text{ m}$



$y = 3 \text{ m}$



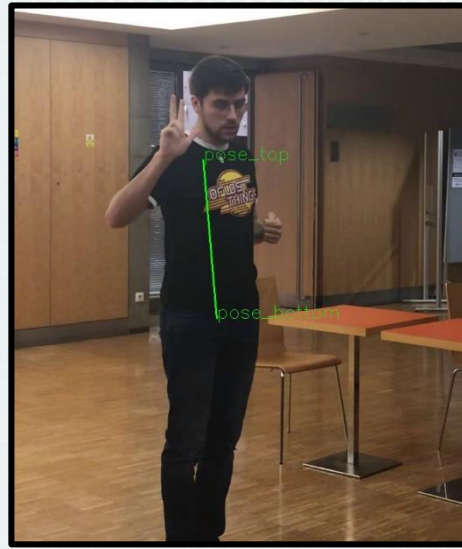
$y = 6 \text{ m}$

Triangulation

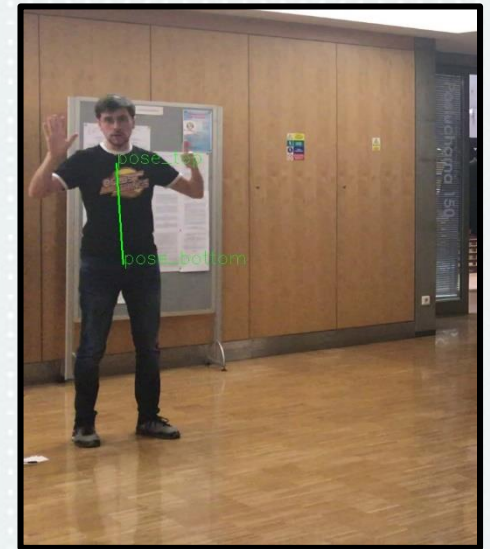
Average person's torso \rightarrow distance from camera



$y = 2 \text{ m}$



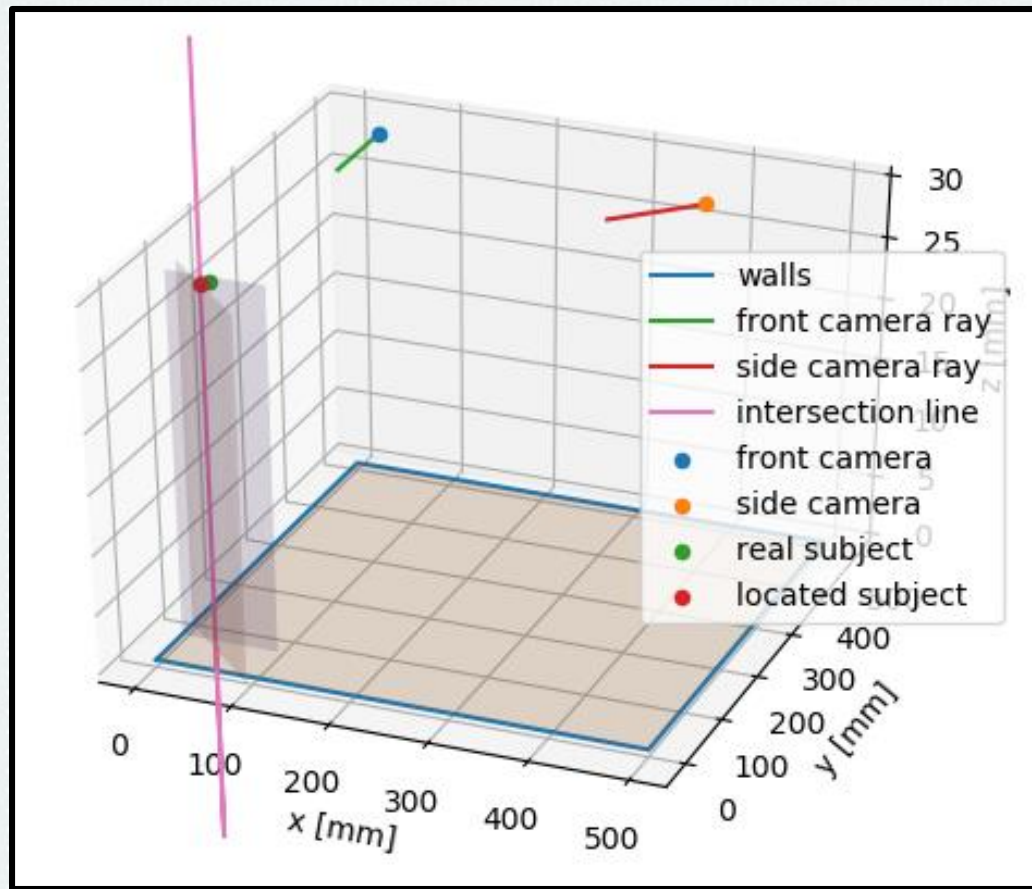
$y = 3 \text{ m}$



$y = 6 \text{ m}$

Triangulation

Intersection of distance planes \rightarrow person's position



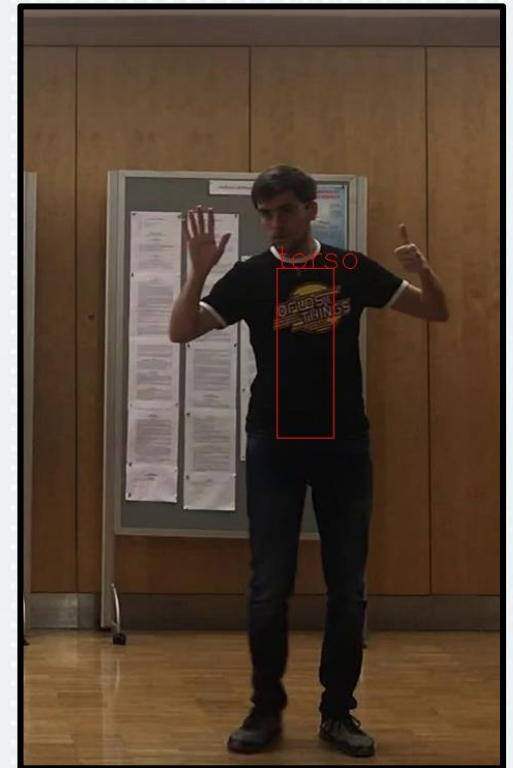
Person Tracking

Similar torso histograms *over time* → same person



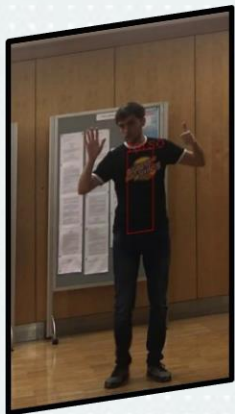
Person Tracking

Similar torso histograms *over time* → same person

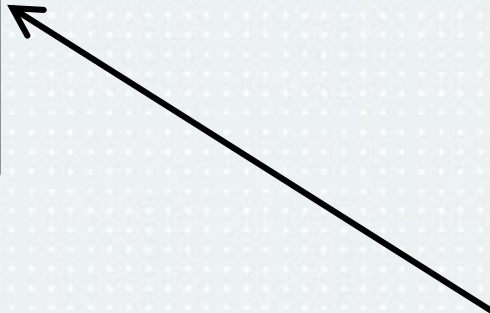


Person Tracking

Similar torso histograms *over time* → same person

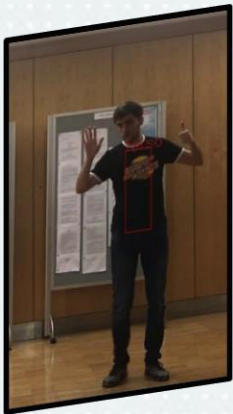


Person 1

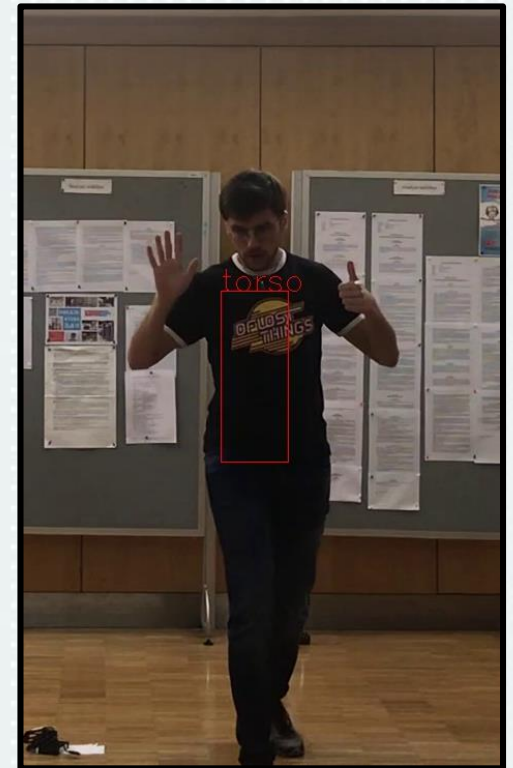


Person Tracking

Similar torso histograms *over time* → same person

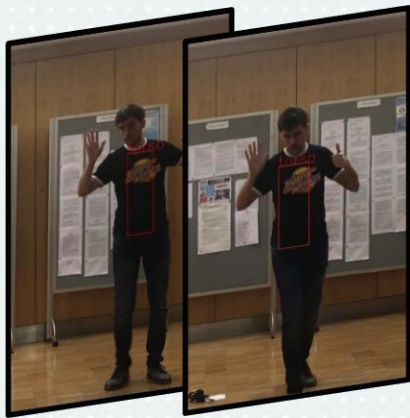


Person 1



Person Tracking

Similar torso histograms *over time* → same person



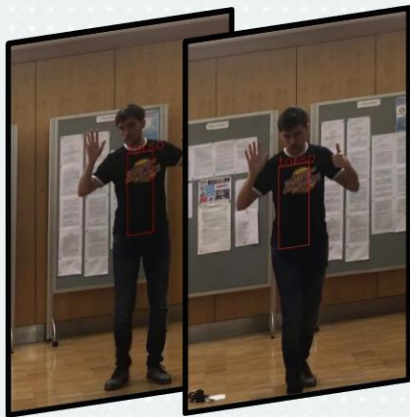
Person 1

*Known
person!*



Person Tracking

Similar torso histograms *over time* \rightarrow same person

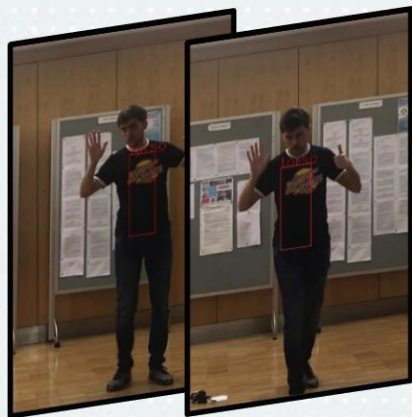


Person 1

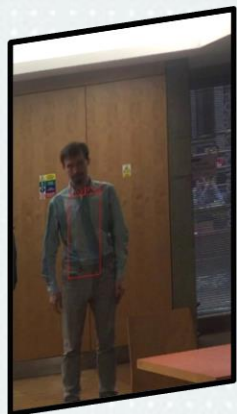


Person Tracking

Similar torso histograms *over time* → same person



Person 1



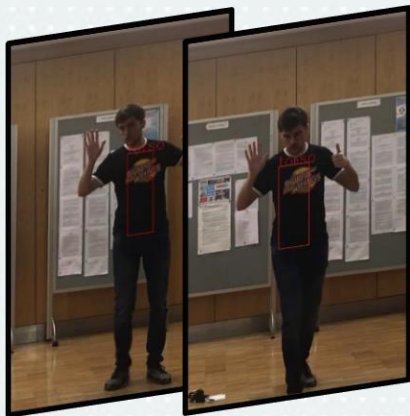
Person 2

*New
person!*



Person Tracking

Similar torso histograms *over time* → same person



Person 1

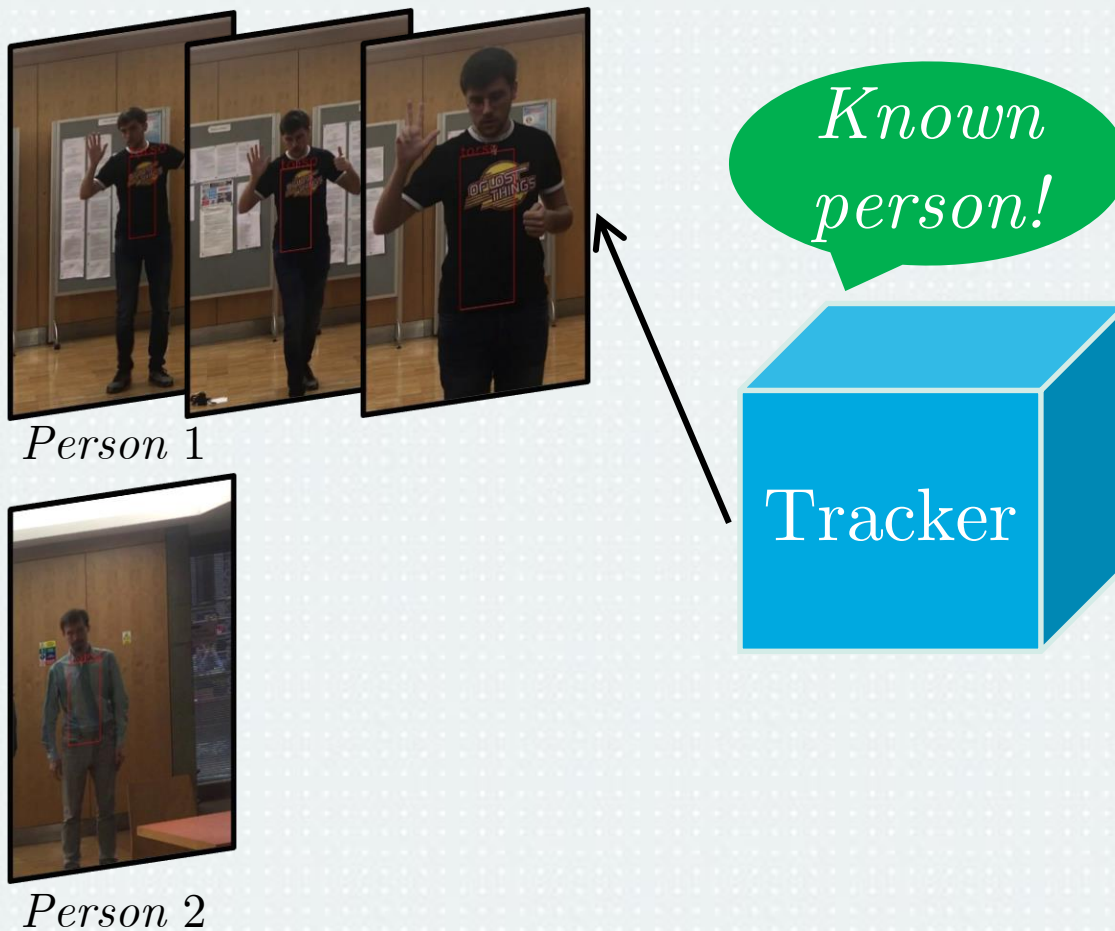


Person 2



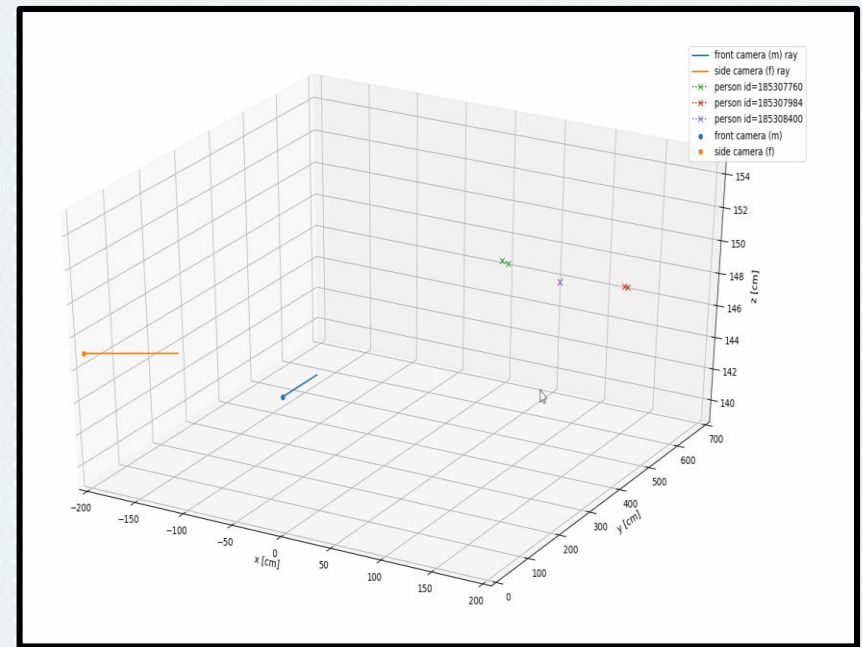
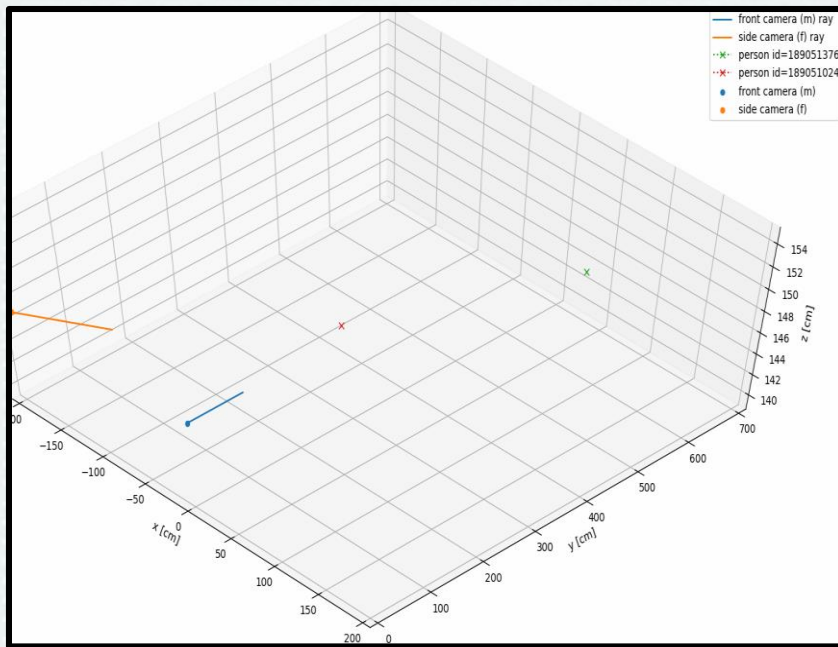
Person Tracking

Similar torso histograms *over time* → same person



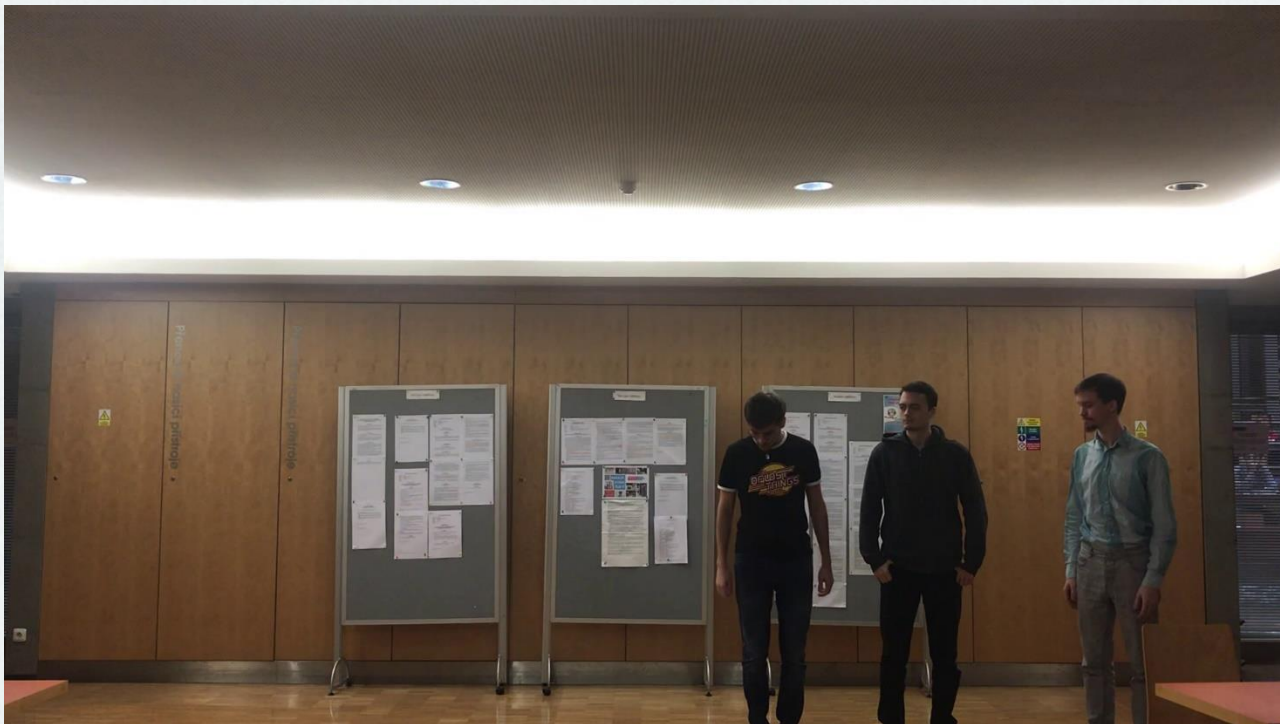
Visualisation

- Paths of all tracked people, positions of cameras
- Interactive 3D model



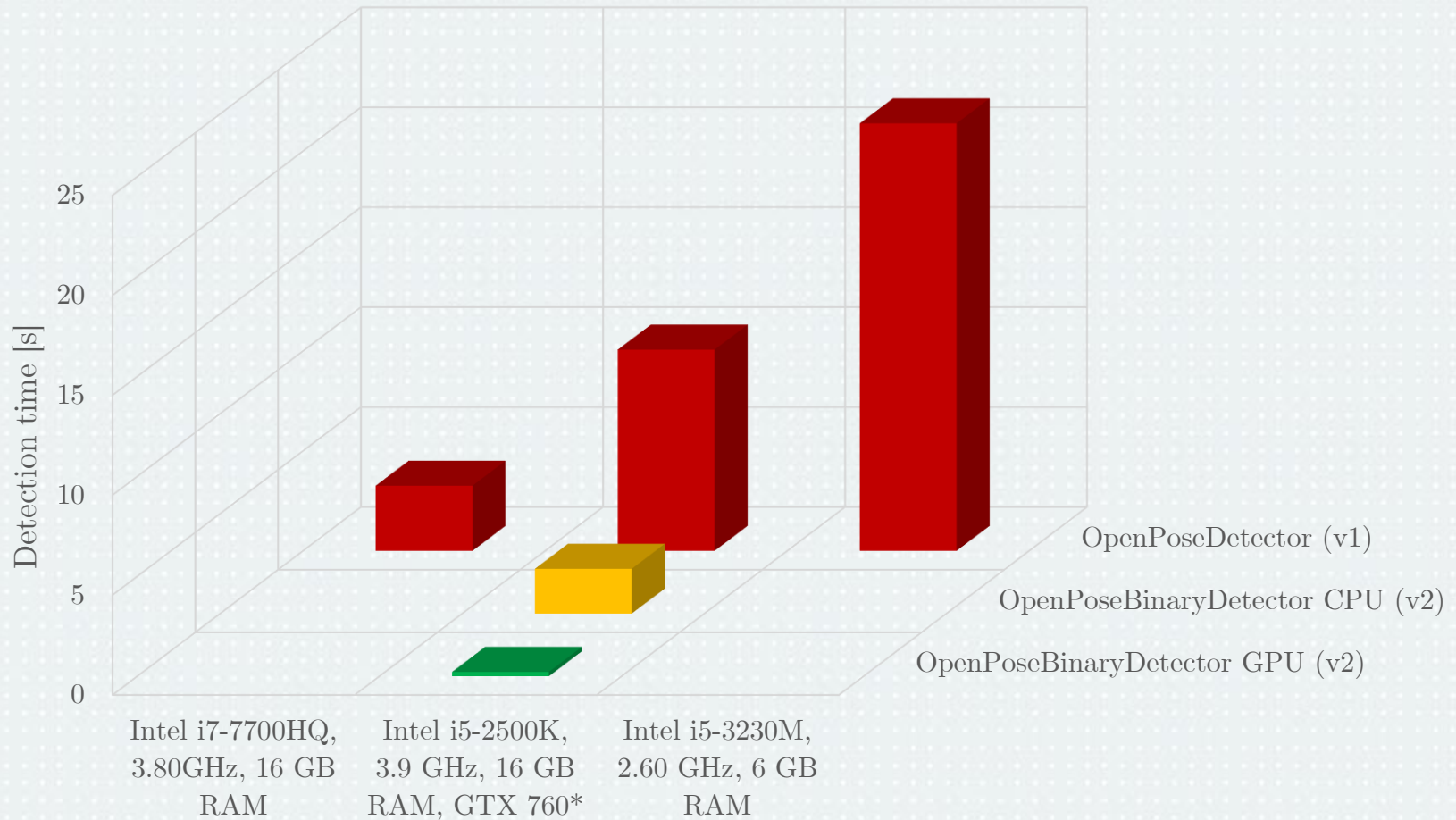
Testing Data

- Own images and videos
- *COCO* dataset for *OpenPose*



Evaluation

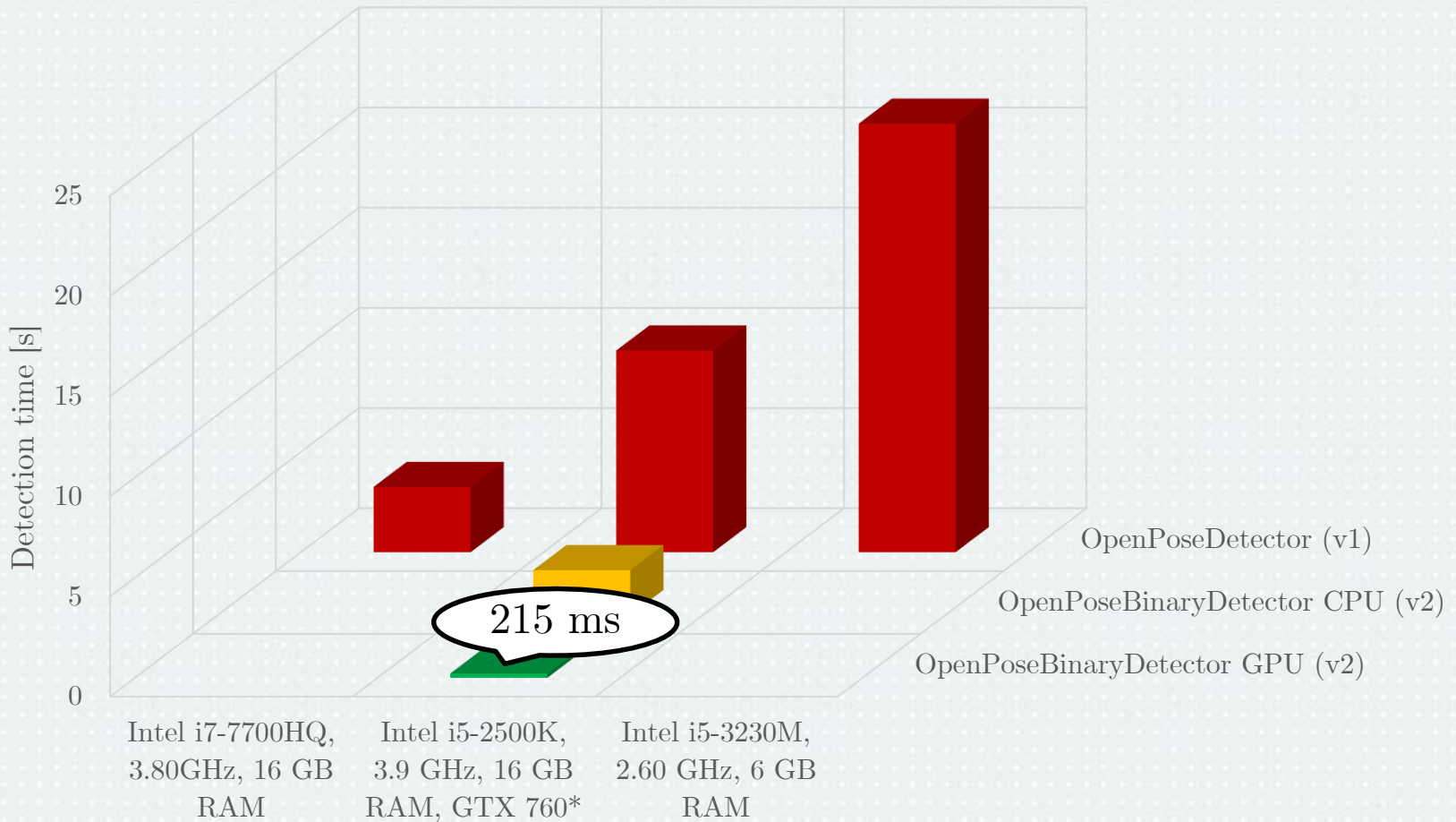
Human Detection Time



* GPU binary start-up time: 2.1 s, CPU binary start-up time: 3.4 s.

Evaluation

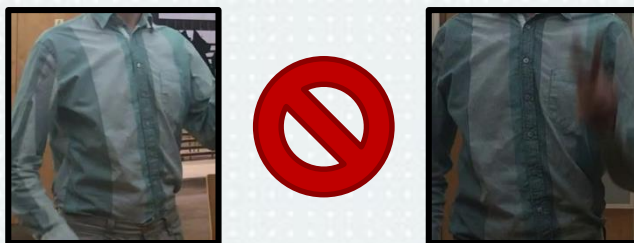
Human Detection Time



* GPU binary start-up time: 2.1 s, CPU binary start-up time: 3.4 s.

Evaluation

Image preprocessing \rightarrow stable matcher and tracker



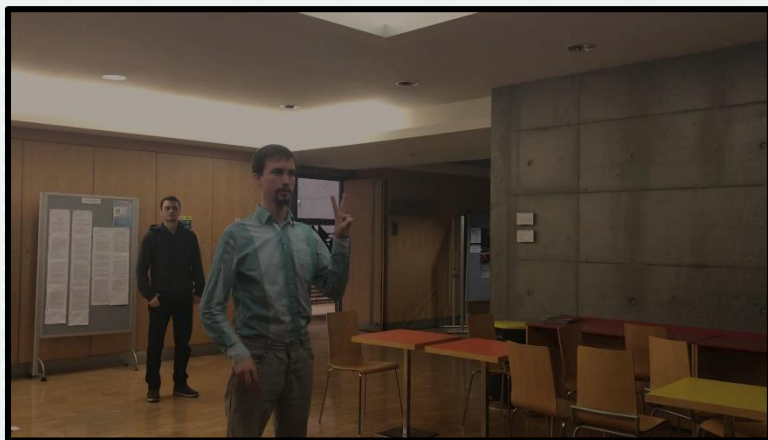
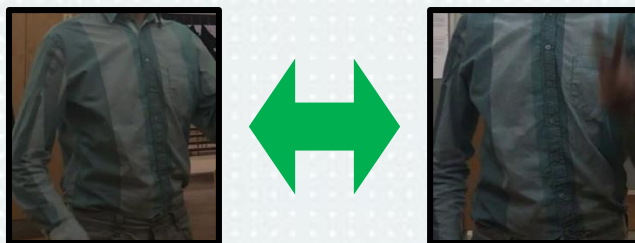
Side original



Front original

Evaluation

Image preprocessing → stable matcher and tracker



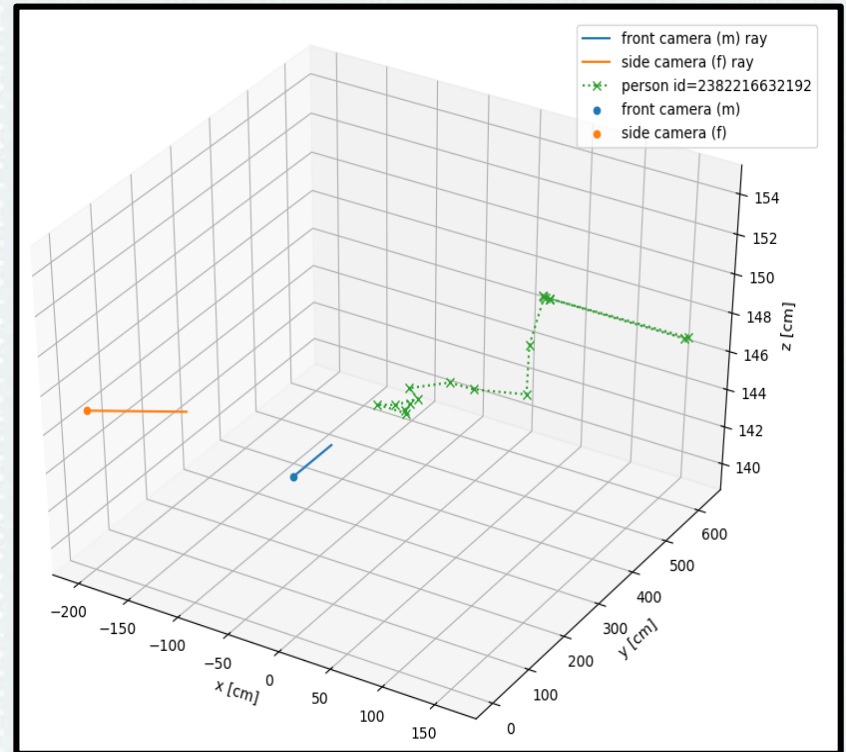
Side preprocessed



Front preprocessed

Evaluation

- **Matching**
torso (t-shirt) based
- **Triangulation**
worst case less than 35 cm
error in 600 cm space.
- **Tracking**
similarity threshold



Pedestrian tracking

Thank you for your attention.

