Sitting Posture Quality Evaluation Using Depth and RGB Camera

Sitting Hamsters

ImagineCup

PeWe@FIIT
personalized web group

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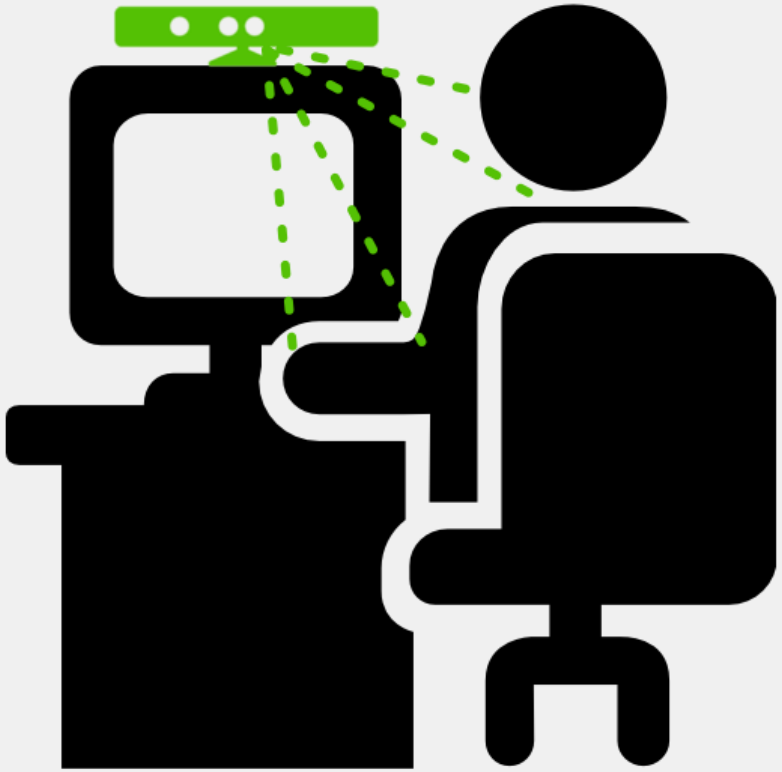
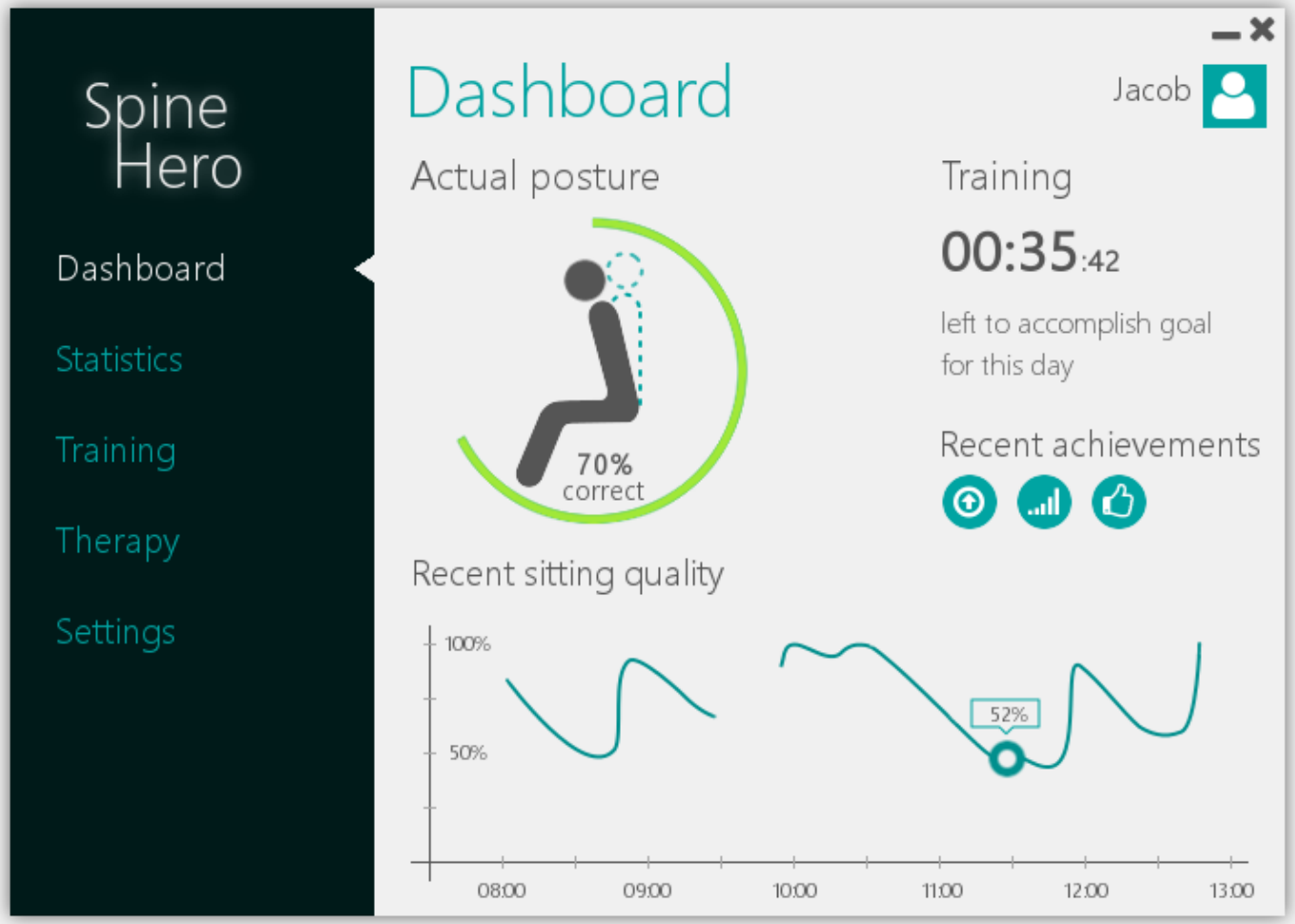
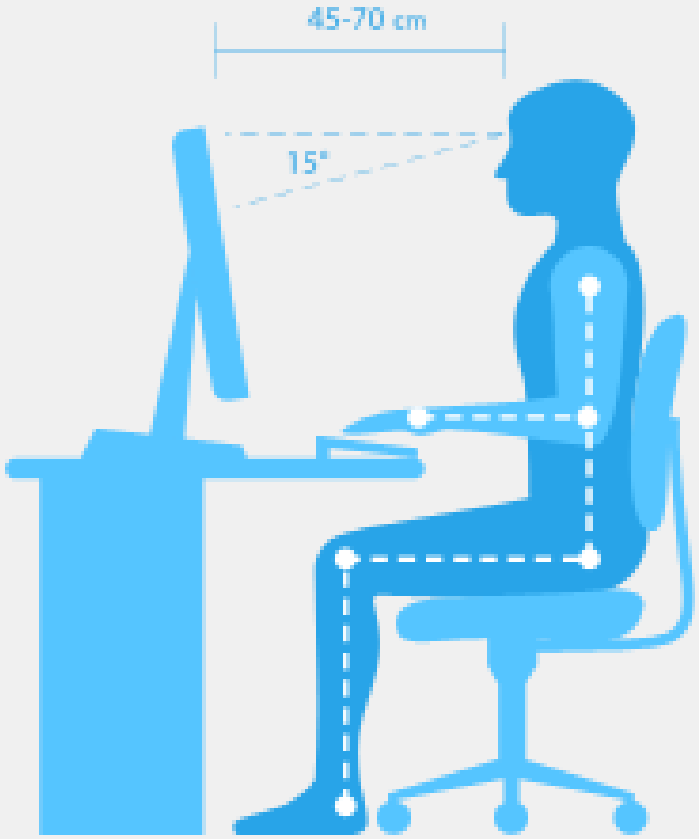
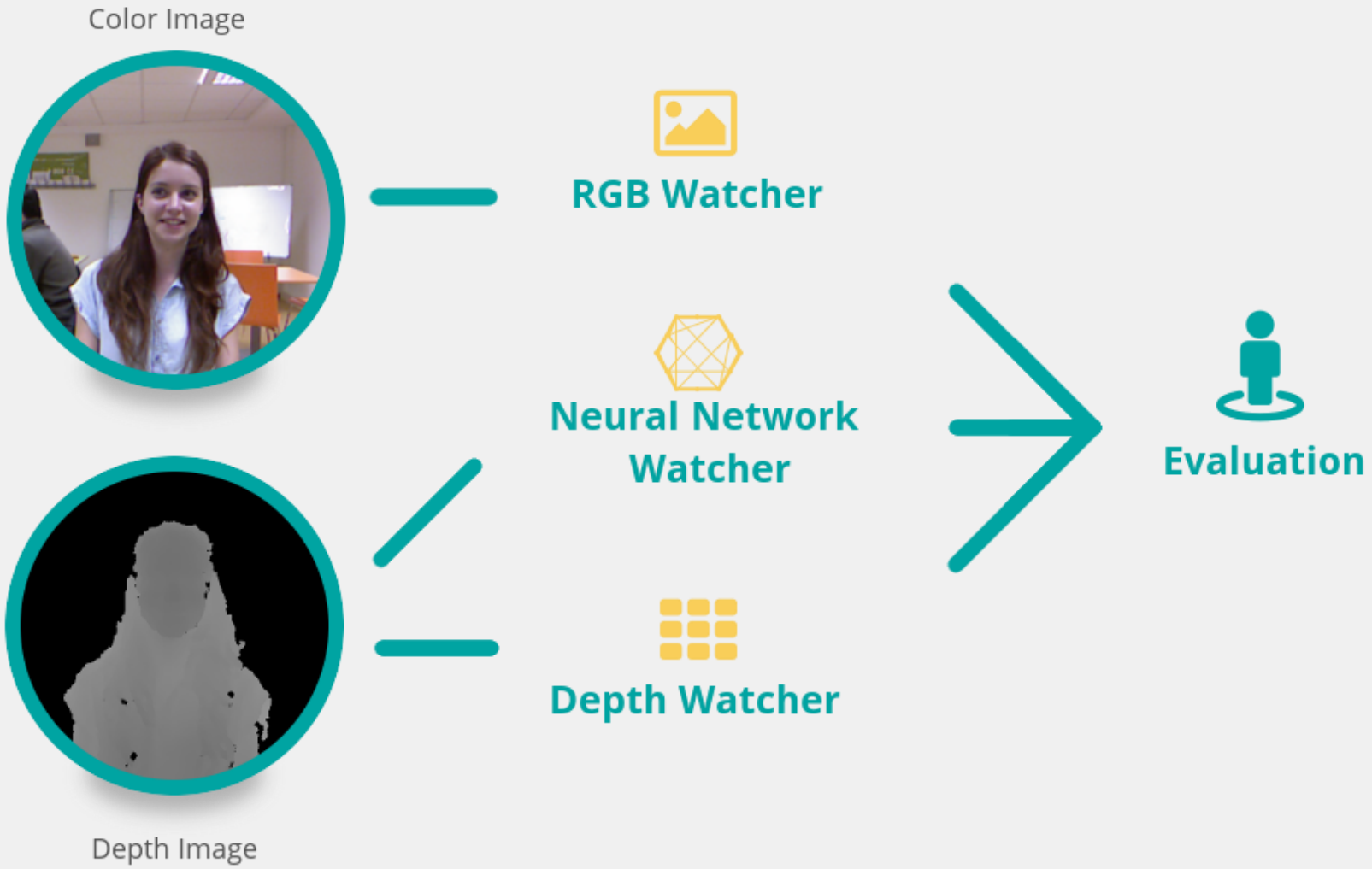




How to sit correctly



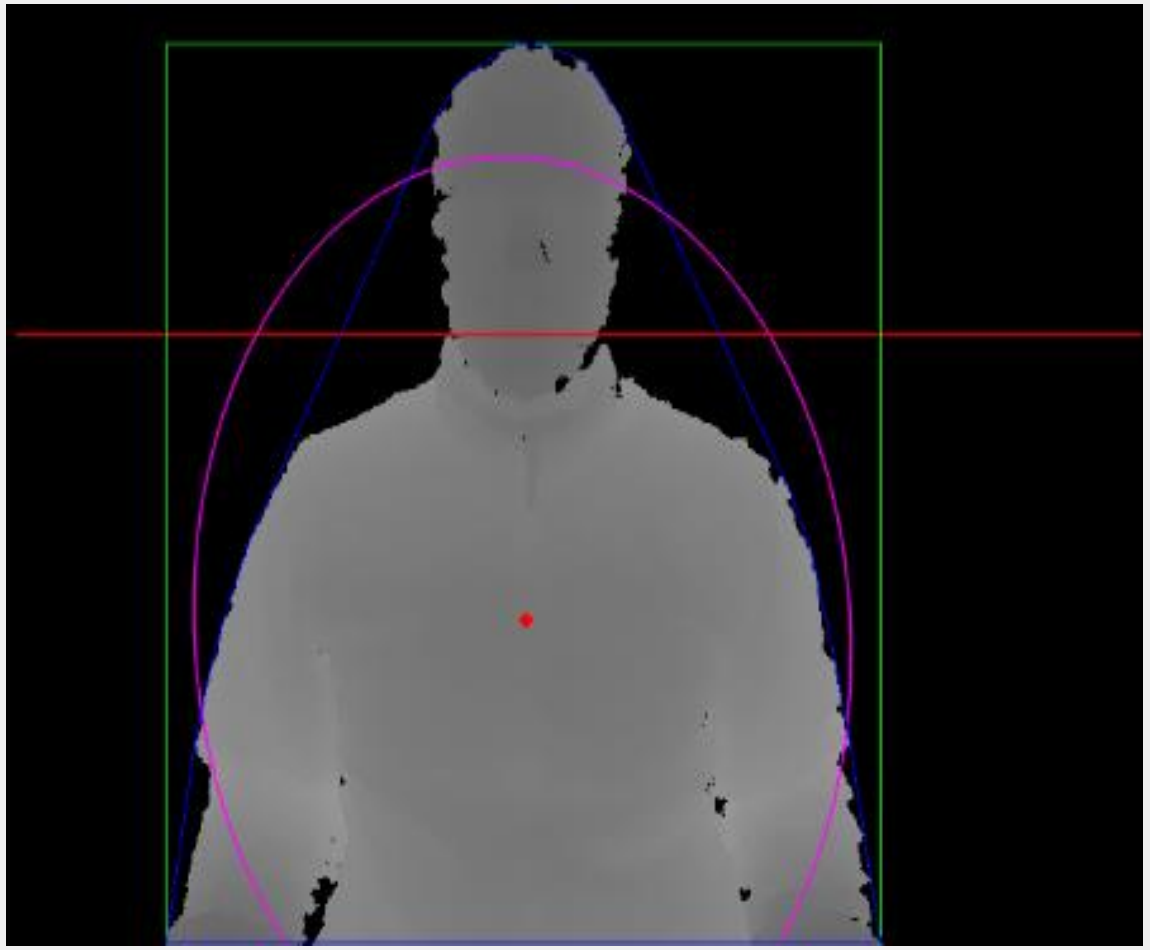
Different methods for better accuracy



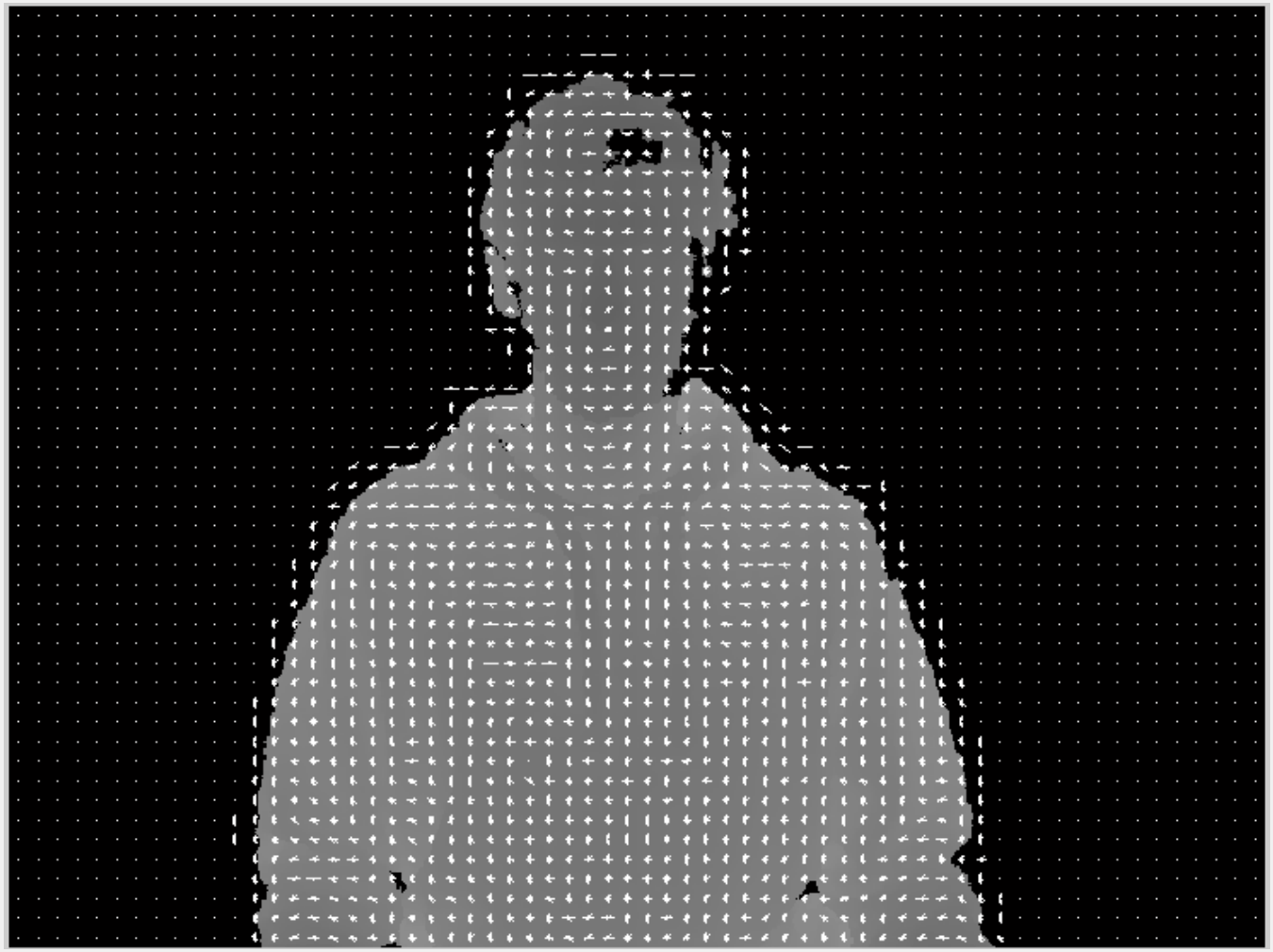
Filter contour with maximum area

Region of interest (ROI) features

- 12 dimensional vector of features
  - Bounding box extent
  - Convex hull extent
  - ROI orientation
  - Centroid coordinates
  - Eccentricity
  - Mean depth
  - Depth with maximum count
  - Ratio of left to right average depth
  - Head to centroid depths difference
  - Top depths with maximum counts
  - Bottom to centroid depths difference

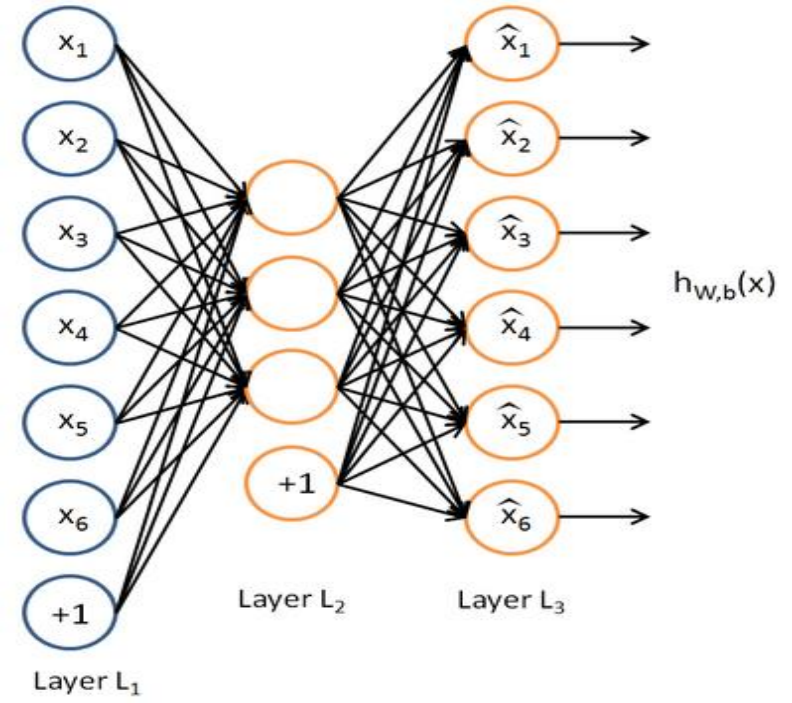


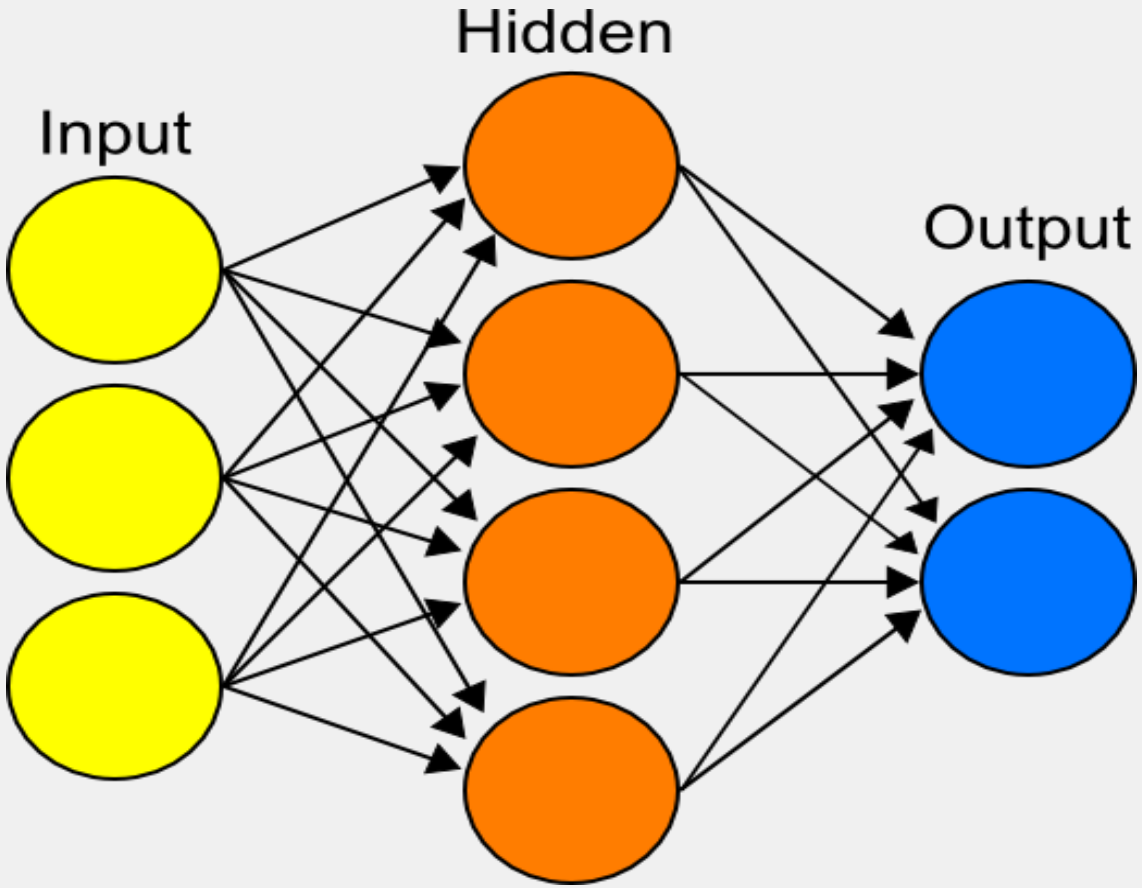
Histogram of oriented gradients



Posture classification

- binary classification
- stacked autoencoder





Experiments

- 10 people (4 women and 6 men)

Table 1. Correct and wrong sitting samples distribution in the sets.

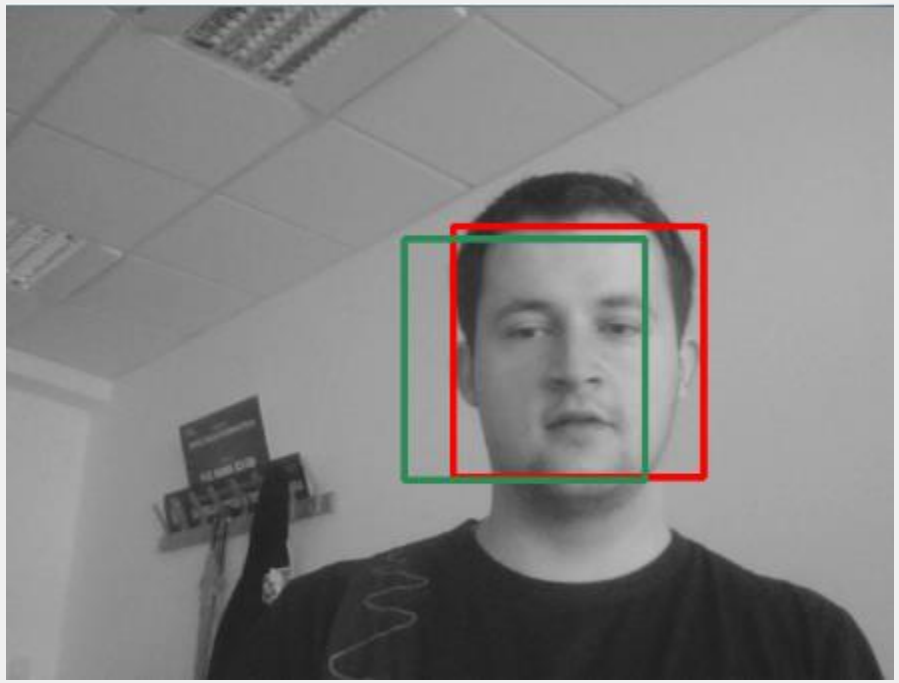
Set	Correct	Wrong
Training	373	613
Validation	89	145
Test	122	160
Total	584	918

Table 3. Posture classification using neural networks.

Net name with layers counts	Threshold[%]	Success rate[%]	TPR	TNR
ROI 12-8-2	50	83,688	0,910	0,781
ROI 12-8-2	80	81,915	0,770	0,856
ROI 12-8-2	30	82,624	0,984	0,706
ROI 12-6-2	50	86,879	0,992	0,775
ROI 12-6-2	85	87,943	0,885	0,875
HOG 2304-900-200-2	50	76,241	0,819	0,718
HOG 2304-1200-400-40-2	50	92,553	0,910	0,938
HOG 1728-800-200-20-2	50	81,915	0,844	0,800
HOG-RGB 2268-900-200-2	70	73,338	0,459	0,956
HOG-RGB 2268-1200-300-80-20-2	50	68,905	0,303	0,987
HOG-RGB 2268-1200-300-2	50	73,243	0,713	0,737
HOG-RGB 5680-900-200-2	70	51,739	0,359	0,587
HOG-RGB 1260-900-200-2	70	53,043	0,621	0,373

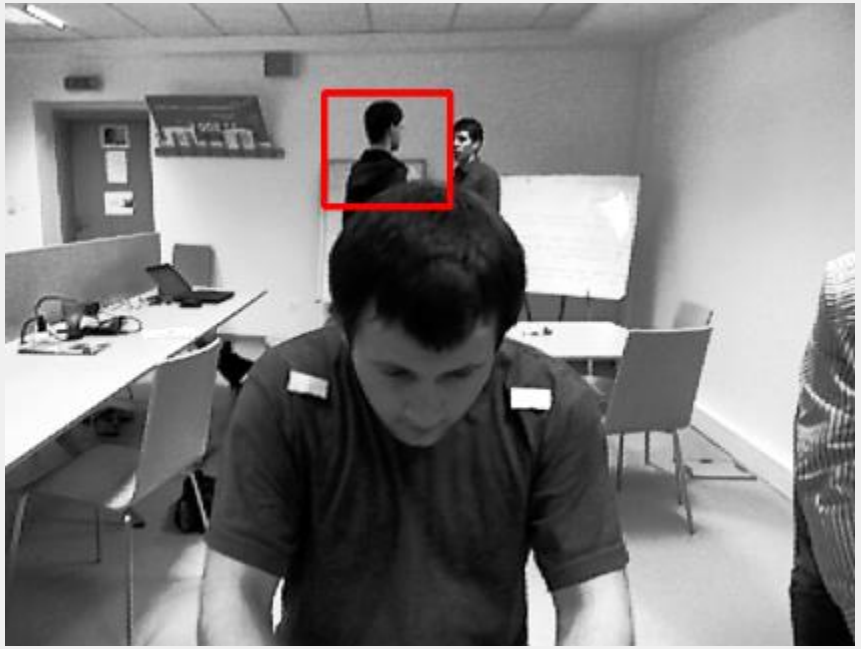
RGB camera recognition

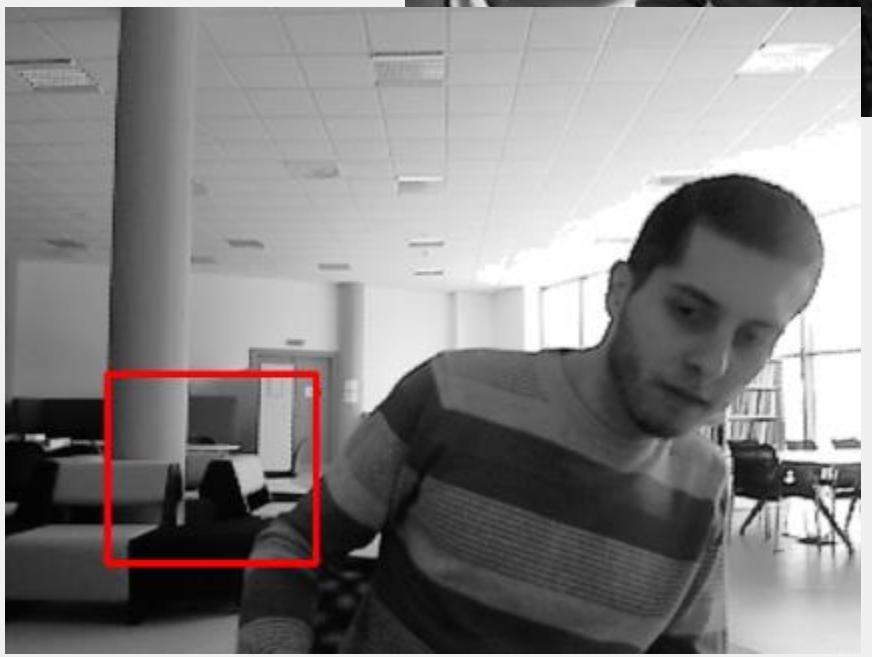
- Face recognition using the OpenCV Haar cascade-classifier
- accuracy 93%
- Compare size of face
- Problem with head rotation



Upper body detection

- Use cascade classifier with 80 % accuracy

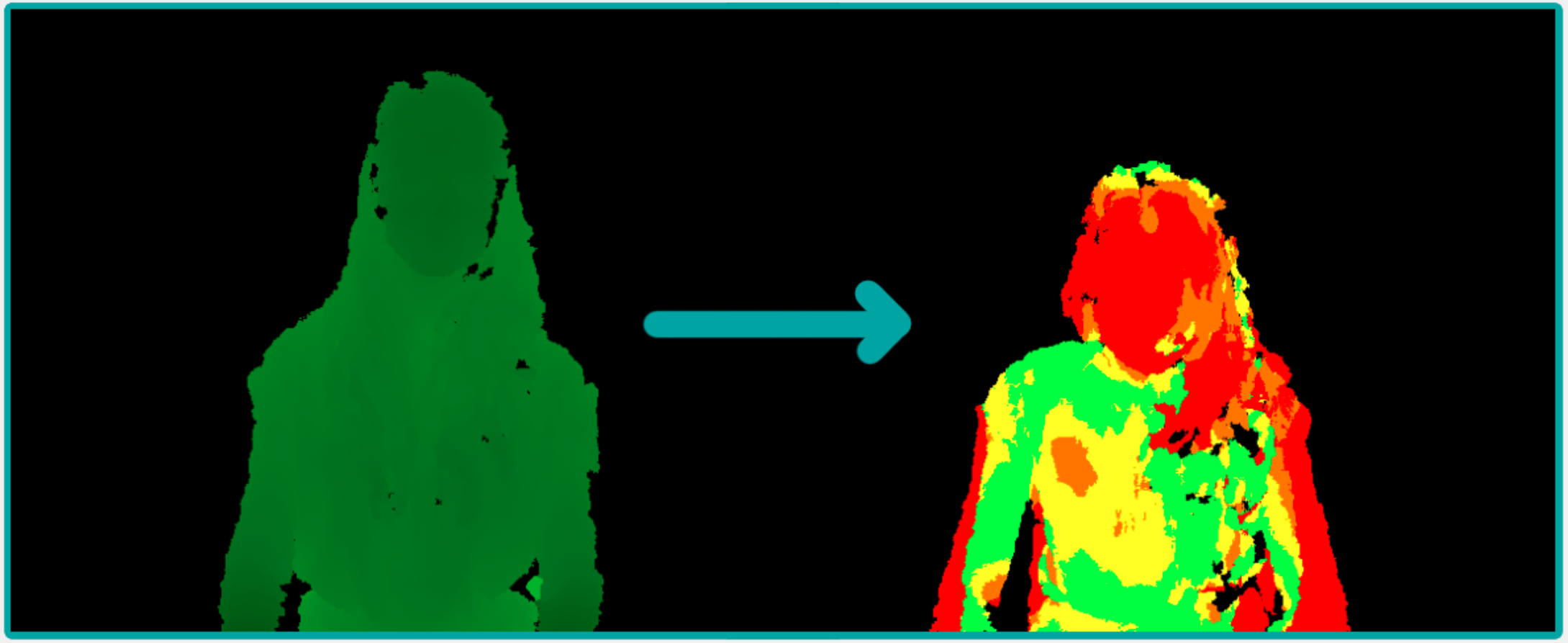




Background subtraction method

- Use Background Subtractor MOG2
- Find contours and centroid and top of head

Depth comparison method



Depth comparison method

- Input
  - Depth image
  - Max area contour as mask (+ topmost point, centroid)

- Compared differences with calibration image:
  - Difference of head to upper and lower upper body
  - Head position (x, y coordinates)
  - Overall depth
  - Difference of left and right part of upper body

Depth comparison method

- Output
  - Correct sitting as a range of values <0 - 100>
  - Approximate detected posture
    - Correct
    - Leaning forward, backward
    - Leaning left, right
    - Slouch
- Problems
  - Bad contour
  - Hands, hair

Prevention is better than cure

- Various approaches for better accuracy
- Non-invasive notifications
- Developing in cooperation with physiotherapists

Sitting Hamsters

SpineHero.com