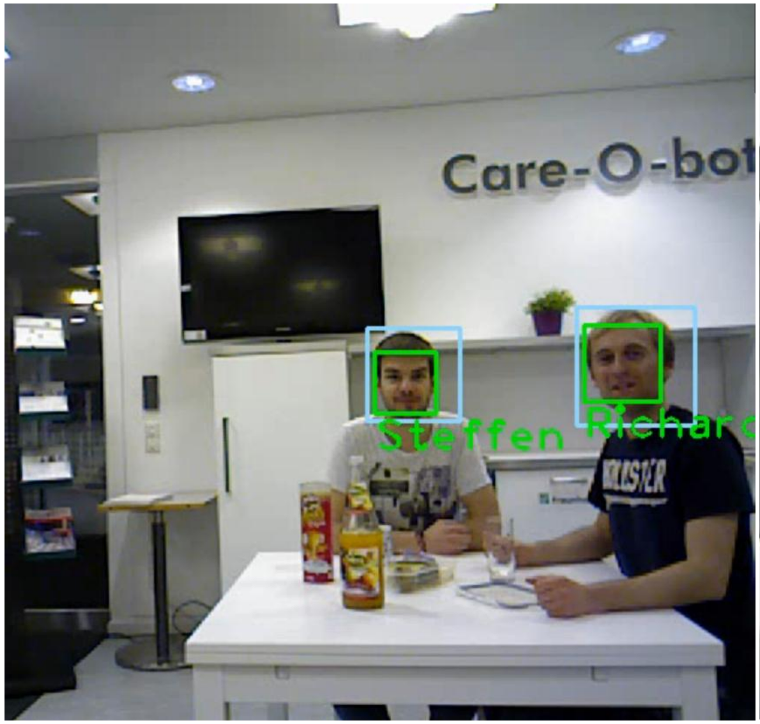
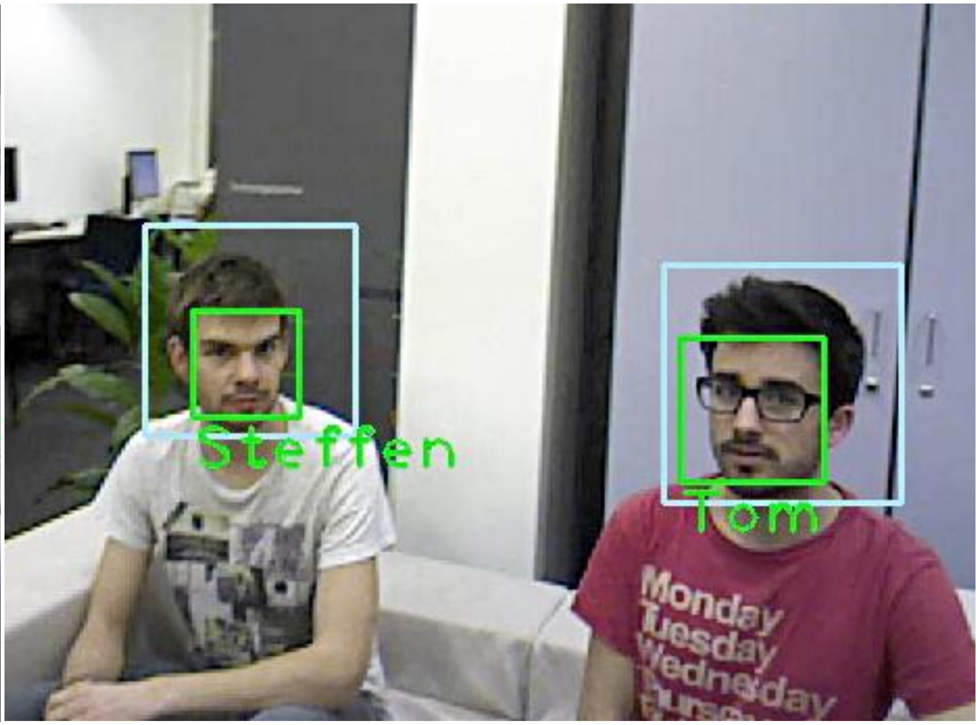
HI RICHARD - PERSONALIZE YOUR ROBOT WITH THE COB_PEOPLE_PERCEPTION STACK

Richard Bormann, Thomas Zwölfer, Jan Fischer

Fraunhofer-Institute for Manufacturing Engineering and Automation IPA





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Introduction

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Introduction

- personalized greeting
- appropriate behavior according to the user's preferences
- user centered services, reminders, etc.

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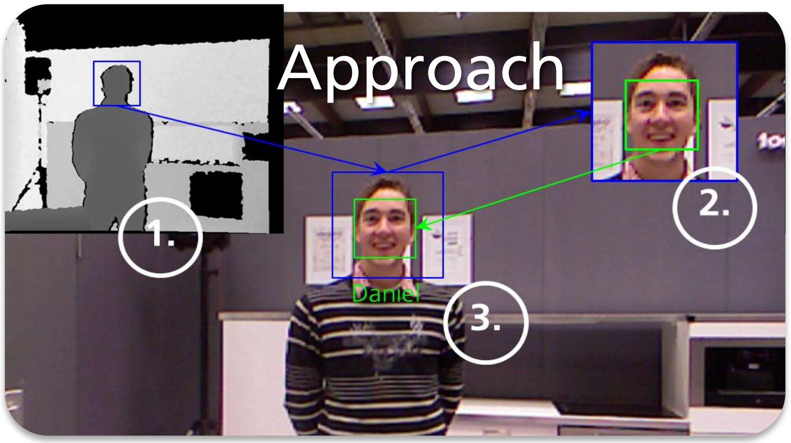
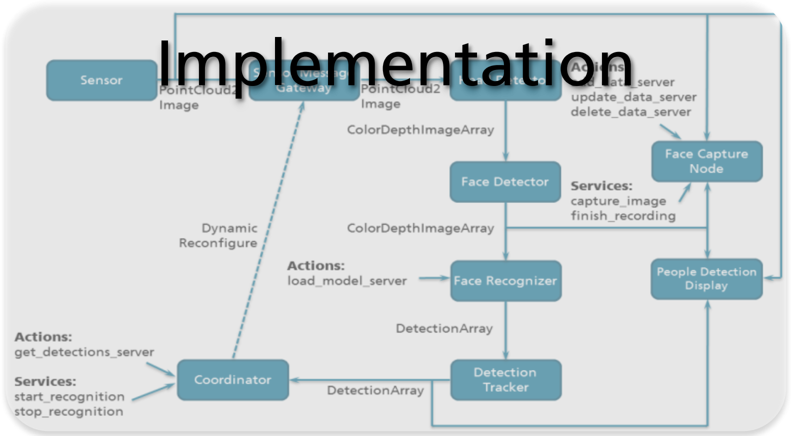
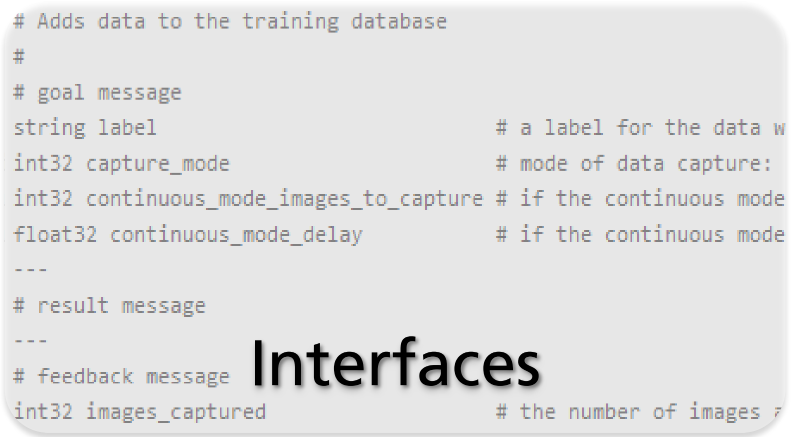
Outline

This talk explains the cob_people_perception stack to detect and identify people. Details on implementation, interfaces and usage will be provided.







```
# Adds data to the training database
#
# goal message
string label                            # a label for the data w
int32 capture_mode                      # mode of data capture:
int32 continuous_mode_images_to_capture # if the continuous mode
float32 continuous_mode_delay           # if the continuous mode
---
# result message
---
# feedback message
int32 images_captured                   # the number of images a
```

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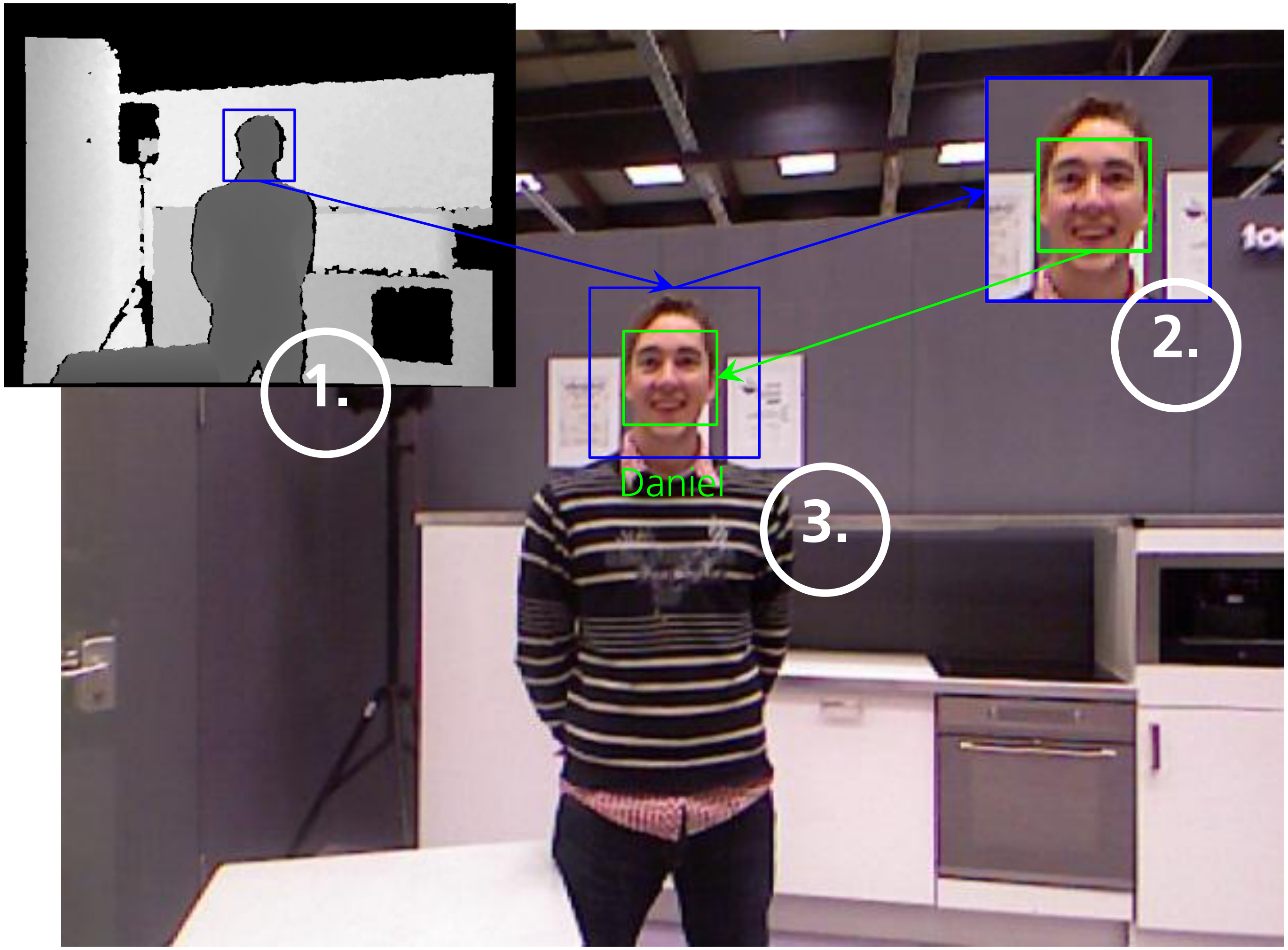
Approach for Person Detection and Identification

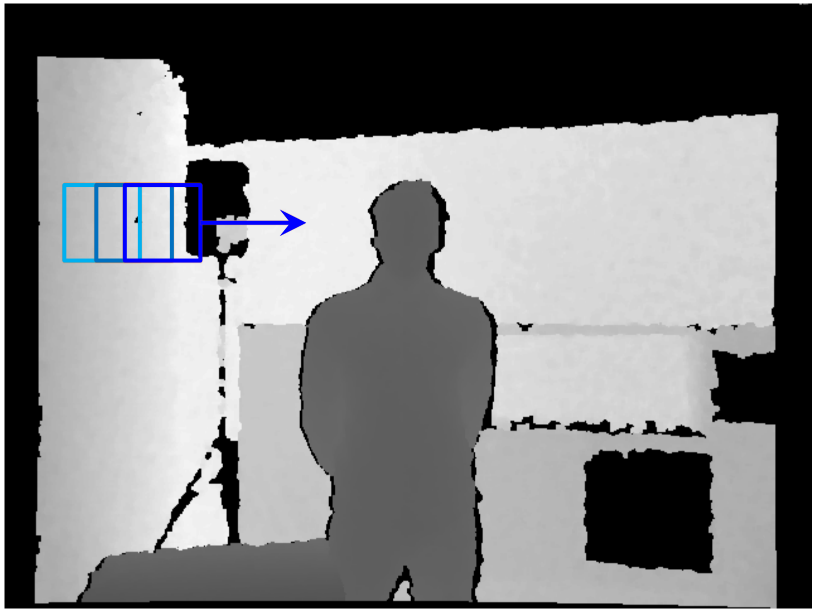
- 3 steps: 1. head detection, 2. face detection and 3. face identification

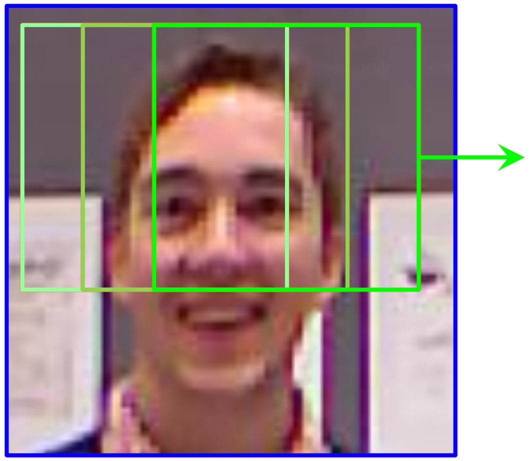


Approach for Person Detection

- head detection in depth image of the scene with Viola-Jones classifier
  $\rightarrow$ cob_people_perception comes with a well-trained classifier cascade for depth data from the Kinect

- face detection in color image patches of the head regions with Viola-Jones classifier
  $\rightarrow$ cob_people_perception uses trained OpenCV classifier



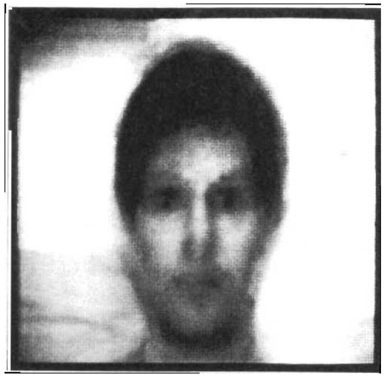


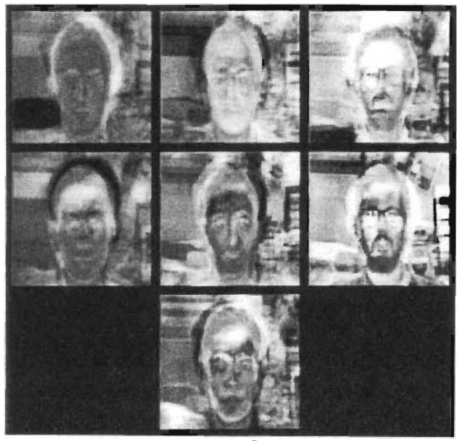
Approach for Person Identification

- Fisherfaces on gray image of the face
  - basically a projection-based method
  - generates the basis of a “face space” from training samples
  - minimizes intra-class variance and maximizes inter-class variance
  - face similarity judged by similarity of face space vectors
- intuition from similar method Eigenfaces:

known people = average image + weighted sum of eigenfaces

average image





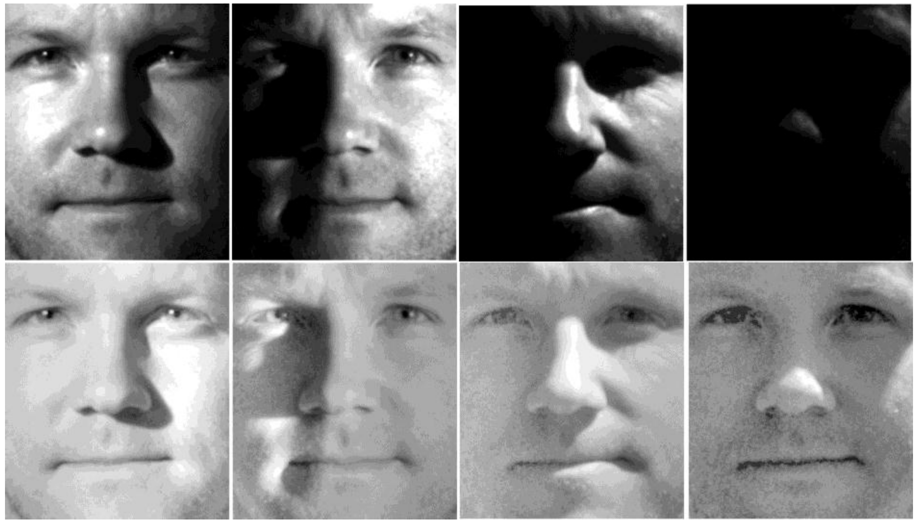
eigenfaces (face space)

images from: Matthew Turk and Alex Pentland

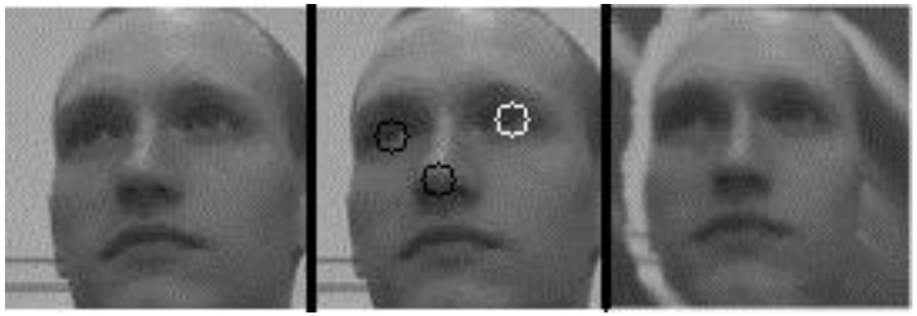
Journal of Cognitive Neuroscience 1991 3:1, 71-86

Approach for Person Identification

- increased robustness of identification through
  - illumination normalization, e.g. by
    - gamma transform combined with discrete cosine transform coefficient scaling



  - head pose alignment, e.g. by
    - detection of eyes and nose and image warping



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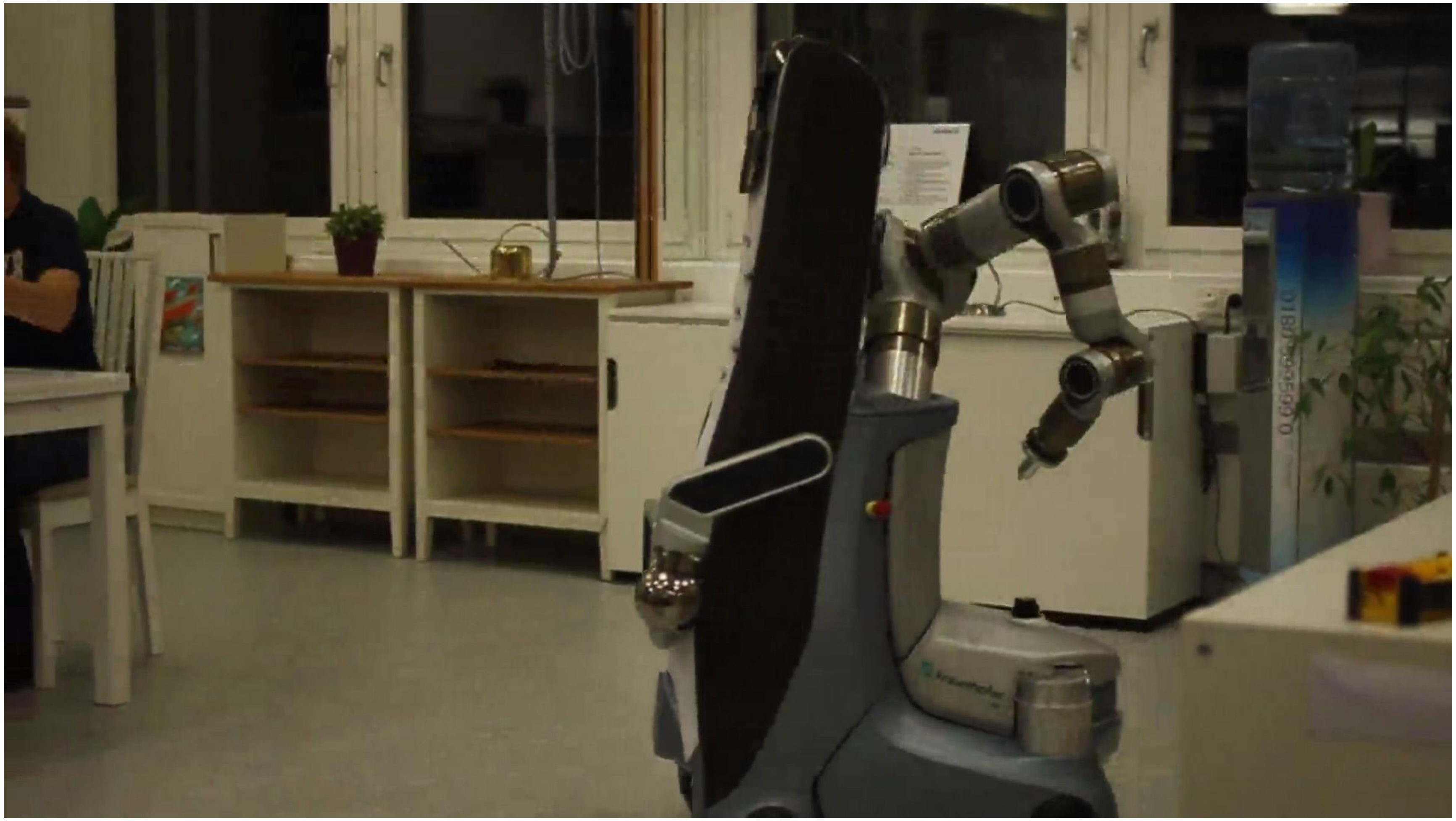
Video – Person Detection and Identification



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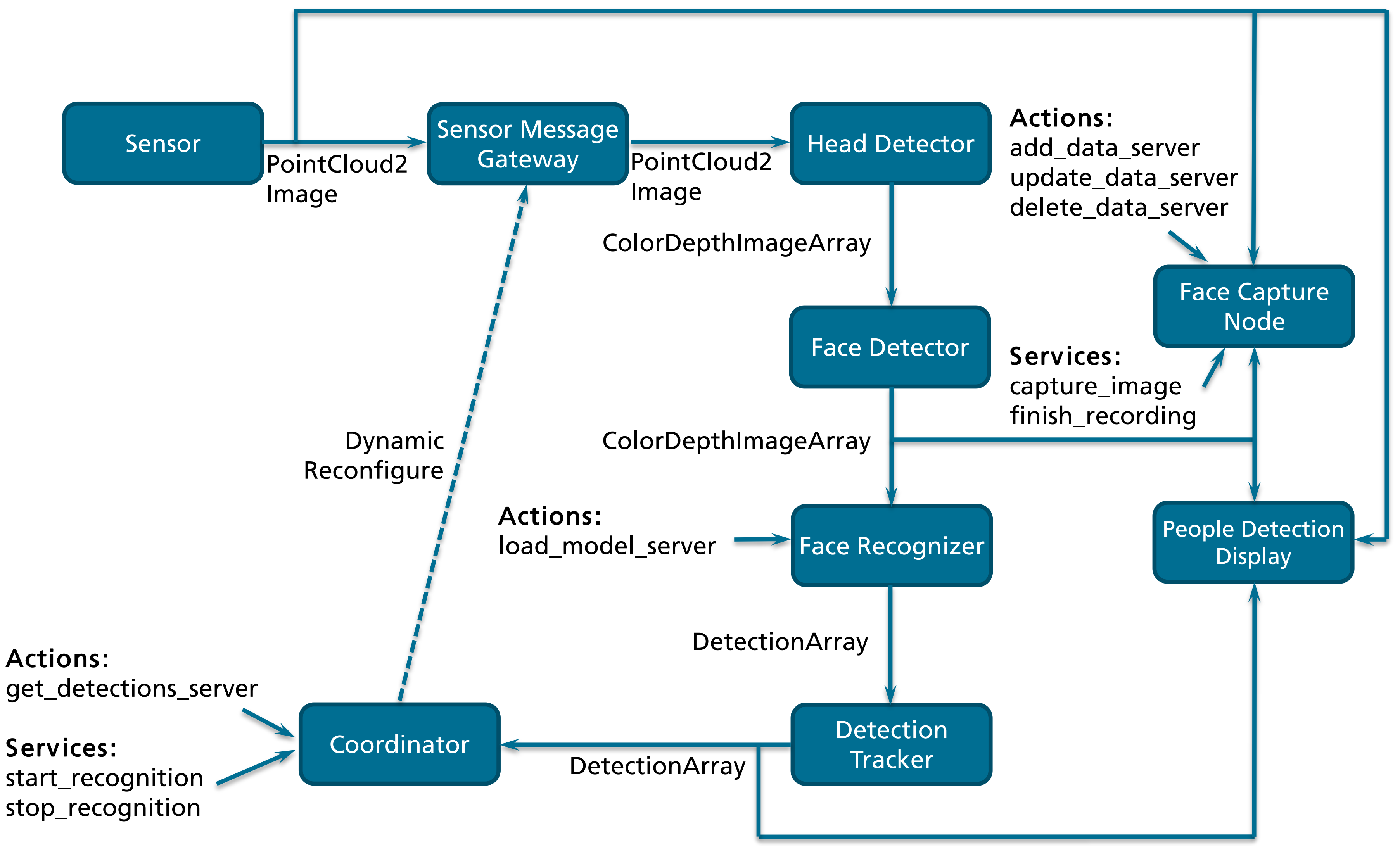
Implementation

- functionality
  - person detection and identification continuously or on demand
  - capture training data for face identification
  - build face recognition models for all known people or just a subset
  - update or delete data for face identification
- division into specialized modules that run as nodes
- advantages and drawbacks of high modularity
  - + exchangeable algorithms
  - + stable interfaces
  - + uncomplicated team work on different nodes
  - - message transfer overhead

Implementation



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Interfaces – Recognizing People

- continuous stream of detections and identifications

  - open camera message gateway with service *start_recognition*
    message type: recognitionTrigger.srv:
    ```
    # request message
    float32 target_frame_rate
    ---
    # response message
    ```

  - close camera message gateway with service *stop_recognition*
    message type: Empty.srv

Interfaces – Recognizing People

- single detection and identification on demand

  - request via action *get_detections_server* (opens message gateway automatically if closed and resets its status afterwards)
    message type: getDetections.action

```
#goal
float32 maximum_message_age
float32 timeout
---
#result
cob_people_detection_msgs/DetectionArray detections
---
#feedback
```

Interfaces – Capturing Training Images of new Persons

- **manual capturing** mode: call service *capture_image* to record an image, and *finish_recording* to quit
- **automatic capturing** mode: automatic recording of *x* images with a timeout of *y* in between
- request via action *add_data_server*
  message type: addData.action

```
# goal message
string label
int32 capture_mode         # 0=manual, 1=continuous
int32 continuous_mode_images_to_capture
float32 continuous_mode_delay
---
# result message
---
# feedback message
int32 images_captured
```

- **update labels** or **delete training data** with actions *update_data_server* and *delete_data_server*

Interfaces – Construct Recognition Model

- build a model for face recognition with Fisherfaces for a specified list of persons that have been recorded to the database before
- request via action *load_model_server*
  message type: loadModel.action

```
# goal message
string[] labels   # list of persons to be recognized
---
# result message
---
# feedback message
```

Video – Demo Application “Search for a Certain Person”

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Usage

- get the software from www.ros.org/wiki/cob_people_perception
- compile
- run a roscore
- start the Kinect driver

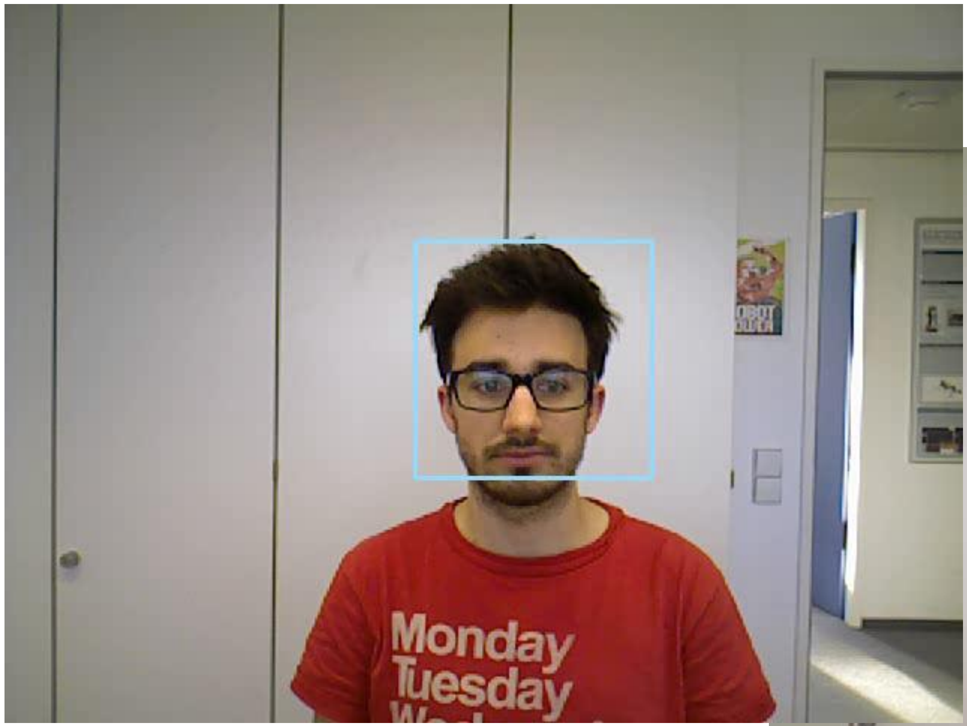
  ```
  roslaunch openni_launch openni.launch
  ```
- launch people detection

  ```
  roslaunch cob_people_detection people_detection.launch
  ```
- start the client for manual usage …

  ```
  rosrun cob_people_detection people_detection_client
  ```
- … or just start your own script or state machine to communicate with the person identification module

Thank you for your interest!

and thanks to the major collaborators within this project



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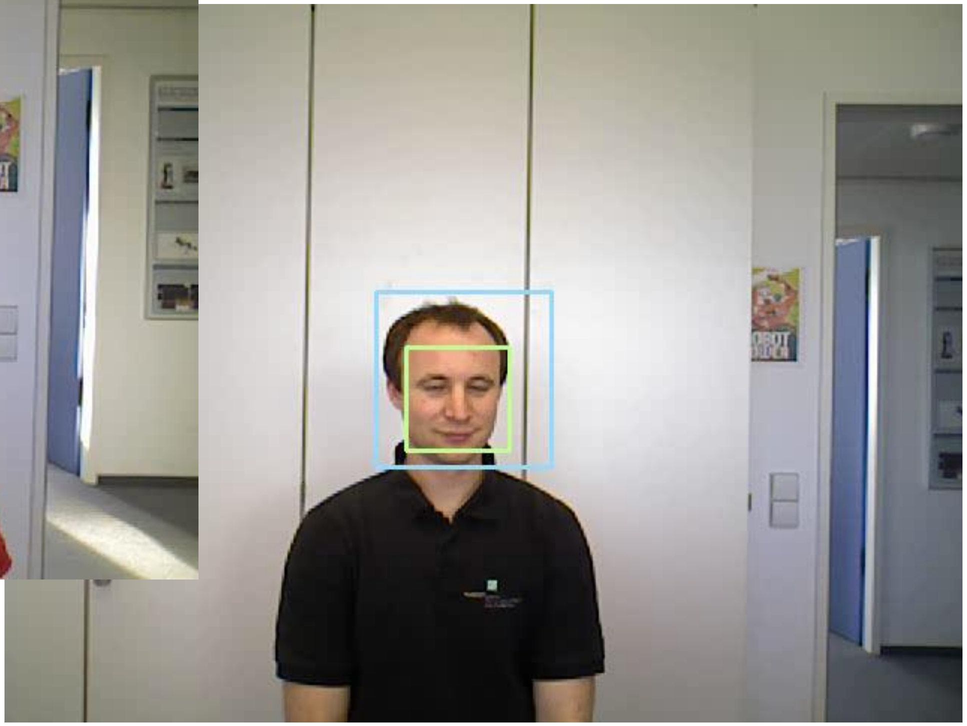

for more infos visit www.ros.org/wiki/cob_people_perception

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