Deliverable 7.4

Mature software architecture for SPRING-ARI

Due Date: 30/11/2022

Main Author: PAL

Contributors: NA

Dissemination: CO - Confidential Deliverable

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### APPROVALS

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EXECUTIVE SUMMARY

The aim of this deliverable is to provide the specifications of customized SPRING Robot, defined in T7.1 Robot Customisation Design, where the software components developed by partners will be integrated in the subsequent tasks of WP7 (T7.2, T7.3, T7.4 and T7.5) and used for validation in WP1.

The document will:

- Explain the general specifications of PAL Robotics ARI robot
- Gather design requirements based on project objectives and partner feedback
- Propose new solutions for vision and audio architecture that provides the highest quality sensing module, based on specified requirements, including the integration of a 360º camera for human behaviour understanding and navigation, as well as a sound acquisition board, to enable multi-person sound tracking and localisation
- Detail the overall hardware and software specifications of the robot
CONTENTS OF DELIVERABLE

The aim of this deliverable is to present the second version of the software architecture of the SPRING-ARI robot, considering the user-cases defined as part of WP1, and the modules being developed between WP2 to WP6.

This deliverable is a code deliverable. As such, this report simply briefly presents the outcome of the second phase of the architecture development, and outlines the progress made on the integration of software components.

As specified at the beginning of the project, the code itself is hosted as git repositories at https://gitlab.inria.fr/spring.

Note that:

- The actual components are under the responsibility of each partners, and are not covered by this deliverable
- The actual testing and deployment of the architecture is covered

The other partners of the consortium have integrated their respective modules and applications.
1. GENERAL OVERVIEW

The SPRING Deliverable D7.4 is about delivering the Mature Software Architecture for the SPRING robot. The Mature Software Architecture is the second iteration of the architecture, after the first one, presented in D7.3.

Compared to the initial software architecture, this new version:

- Is completely specified (however, some nodes are not yet fully implemented or released);
- Relies on the ROS4HRI standard (https://www.ros.org/reps/rep-0155.html, note that this standard itself has been developed by PAL Robotics in the frame of the SPRING project);
- Has been deployed on the partners' robots;
- Has been tested in several occasion at the Broca hospital, both during internal integration weeks, and during the Broca user study which took place in October 2022.

This deliverable is a code deliverable. As specified at the beginning of the project, the code itself is hosted as a set of git repositories at https://gitlab.inria.fr/spring.

In particular, the SPRING architecture is formally described in this repository:

https://gitlab.inria.fr/spring/wp7_ari/spring-architecture

The rest of this document, presenting the list of ROS nodes and their relationships, has been automatically generated from the formal architecture description. Note that a tool (called Boxology) has been specifically developed for the project to easily visualise, edit and export the architecture. The tool is available here: https://github.com/severin-lemaignan/boxology/tree/spring

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This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.
DETAILED DESCRIPTION OF EACH MODULE

BIU

audio_processing_mode

This node performs:
- speech echo cancelation,
- single microphone audio enhancement,

The node audio_processing_mode (id: audio_processing_mode) is maintained by BIU.

Status

Implemented. Current release/branch: BIU_dev

Source code repository:
https://gitlab.inria.fr/spring/wp3_av_perception/speech-enhancement

Inputs

- Topic subscription: /audio/raw_audio [spring_msgs/RawAudioData]

Outputs

- Topic publication: /audio/enh_audio [spring_msgs/RawAudioData]

Dependencies

- spring_msgs/RawAudioData

riva_asr

The node riva_asr (id: riva_asr) is maintained by BIU.

Status

Implemented. Current release/branch: main
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

Source code repository:

https://gitlab.inria.fr/spring/wp3_av_perception/riva_asr_ros_client

**Inputs**

- Topic subscription: `/h/v/tracked` [hri_msgs/IdsList]
- Topic subscription: `/humans/voices/<id>/audio` [audio_common_msgs/AudioData]

**Outputs**

- Topic publication: `/humans/voices/<id>/speech` [hri_msgs/LiveSpeech]

**Dependencies**

- hri_msgs/LiveSpeech
- hri_msgs/IdsList
- audio_common_msgs/AudioData

**source separation + localisation**

The node `source separation + localisation` (id: `sourceseparationLocalisation`) is maintained by BIU.

**Status**

Not yet implemented or released

**Inputs**

- Topic subscription: `/audio/enh_audio` [spring_msgs/RawAudioData]

**Outputs**

- Topic publication: `/audio/doa*` [std_msgs/Float32]
- Topic publication: `/audio/stream*` [audio_common_msgs/AudioData]

**Dependencies**

- std_msgs/Float32
speakers_id

The node speakers_id (id: speakers_id) is maintained by BIU.

Status

Not yet implemented or released

Inputs

- Topic subscription: /audio/doa* [std_msgs/Float32]
- Topic subscription: /audio/stream* [audio_common_msgs/AudioData]
- Topic subscription: /audio/ego_audio [audio_common_msgs/AudioData]
- Topic subscription: /audio/enh_audio [spring_msgs/RawAudioData]

Outputs

- Topic publication: /humans/voices/<id>/is_speaking [std_msgs/Bool]
- Topic publication: /h/v/tracked [hri_msgs/IdsList]
- Output: /audio/vad
- Topic publication: /h/v/known [hri_msgs/IdsList]
- Topic publication: /humans/voices/<id>/doa [std_msgs/Float32]
- Topic publication: /humans/voices/<id>/audio [audio_common_msgs/AudioData]
- Topic publication: /humans/candidate_matches [hri_msgs/IdsMatch]

Dependencies

- std_msgs/Bool
- hri_msgs/IdsList
- std_msgs/Empty
Voice-body matching

The node Voice-body matching (id: voicebodymatching) is maintained by BIU.

Status

This node is not yet implemented.

Inputs

- Input: tf: /face_id (tf)
- Input: tf: /voice_id (tf)

Outputs

- Topic publication: /humans/candidate_matches [hri_msgs/IdsMatch]

Dependencies

- tf/transform_listener
- hri_msgs/IdsMatch

CVUT

InLoc-ROS

The node InLoc-ROS (id: inlocros) is maintained by CVUT.

Status

This node is not yet implemented.

Inputs

- Input: localisation prior
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

- **Topic subscription:** /camera_torso/color/image_torso [sensor_msgs/Image]
- **Topic subscription:** /camera_head/color/image_head [sensor_msgs/Image]

**Outputs**
- Output: dense 3d map
- Output: tf: /odom (tf)

**Dependencies**
- std_msgs/Empty
- tf/transform_broadcaster
- sensor_msgs/Image

**InLoc Server**

The node InLoc Server (id: inlocserver) is maintained by CVUT.

**Status**

Not yet implemented or released

**Inputs**

**Outputs**

**Object detection/identification/localisation**

The node Object detection/identification/localisation (id: objectdetectionidentificationlocalisation) is maintained by CVUT.

**Status**

This node is not yet implemented.

**Inputs**

- **Topic subscription:** /camera_head/color/image_raw [sensor_msgs/Image]

**Outputs**

- **Topic publication:** /detected_objects [spring_msgs/DetectedObjectArray]
Dependencies

- sensor_msgs/Image
- spring_msgs/DetectedObjectArray

Occupancy map

The node Occupancy map (id: occupancymap) is maintained by CVUT.

Status

This node is not yet implemented.

Inputs

- Input: dense 3d map
- Input: TF (bodies)

Outputs

- Topic publication: /map_refined [nav_msgs/OccupancyGrid]

Dependencies

- std_msgs/Empty
- nav_msgs/OccupancyGrid

Semantic mapping

The node Semantic mapping (id: semanticmapping) is maintained by CVUT.

Status

This node is not yet implemented.

Inputs

- Input: dense 3d map
- Topic subscription: /detected_objects [spring_msgs/DetectedObjectArray]

Outputs
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This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

### Dependencies
- std_msgs/Empty
- spring_msgs/DetectedObjectArray

### ERM

#### Robot GUI

*The node Robot GUI (id: robotgui) is maintained by ERM.*

#### Status

This node is not yet implemented.

#### Inputs
- Input: /tts/feedback
- Input: additional support material
- Topic subscription: /humans/voices/<id>/speech [hri_msgs/LiveSpeech]
- Input: speech output

#### Outputs

### Dependencies
- std_msgs/Empty
- hri_msgs/LiveSpeech

### HWU

#### alana_node

*The node alana_node (id: alana_node) is maintained by HWU.*

#### Status

Not yet implemented or released
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

**Inputs**

- Input: /get_answer

**Outputs**

- Output: /response

**Dependencies**

- std_msgs/Empty

**dialogue_arbiter**

The node `dialogue_arbiter` (id: dialogue_arbiter) is maintained by HWU.

**Status**

Implemented. Current release/branch: spring_dev

Source code repository: git@gitlab.inria.fr:spring/wp5_spoken_conversations/dialogue.git

**Inputs**

- Input: /eos

- Input: /dialogue_speech

- Input: interaction messages

**Outputs**

- Output: DialogueState

- Output: next utterance

**Dependencies**

- std_msgs/Empty

**dialogue_speech**

The node `dialogue_speech` (id: dialogue_speech) is maintained by HWU.

**Status**
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

Not yet implemented or released

**Inputs**

- Topic subscription: /humans/voices/<id>/speech [hri_msgs/LiveSpeech]

**Outputs**

- Output: /dialogue_speech
- Output: /eos

**Dependencies**

- std_msgs/Empty
- hri_msgs/LiveSpeech

**google_translate**

*The node google_translate (id: google_translate) is maintained by HWU.*

**Status**

Not yet implemented or released

**Inputs**

- Input: /get_answer

**Outputs**

- Output: /response

**Dependencies**

- std_msgs/Empty

**interaction_manager**

*The node interaction_manager (id: interaction_manager) is maintained by HWU.*

**Status**

Implemented. Current release/branch: spring_dev

Source code repository: git@gitlab.inria.fr:spring/wp5_spoken_conversations/interaction.git
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

Inputs

- Input: semantic scene description
- Input: TF
- Input: input
- Input: dialogue state
- Input: robot state
- Topic subscription: /humans/persons/<id>/softbiometrics [hri_msgs/Softbiometrics]

Outputs

- Output: gestures

Dependencies

- std_msgs/Empty
- hri_msgs/Softbiometrics

recipe_planner

The node recipe_planner (id: recipe_planner) is maintained by HWU.

Status

Implemented. Current release/branch: spring_dev

Source code repository:
git@gitlab.inria.fr:spring/wp5_spoken_conversations/plan_actions.git

Inputs

- Input: semantic scene description
- Topic subscription: /humans/persons/<id>/softbiometrics [hri_msgs/Softbiometrics]
- Input: dialogue state

Outputs
Output: interaction state

Output: plan

Dependencies

- std_msgs/Empty
- hri_msgs/Softbiometrics

**ros_petri_net_node**

*ros_petri_net_node is...*

*The node ros_petri_net_node (id: ros_petri_net_node) is maintained by HWU.*

**Status**

Not yet implemented or released

**Inputs**

- Input: plan

**Outputs**

- Output: look_at goals
- Output: navigation goals

**Dependencies**

- std_msgs/Empty

**social_scene_context_understanding**

*The node social_scene_context_understanding (id: social_scene_context_understanding) is maintained by HWU.*

**Status**

Implemented. Current release/branch: spring_dev

Source code repository: git@gitlab.inria.fr:spring/wp5_spoken_conversations/interaction.git

**Inputs**
● Input: scene graph

Outputs

● Output: semantic description

Dependencies

● std_msgs/Empty

social_state_analyzer

The node social_state_analyzer (id: social_state_analyzer) is maintained by HWU.

Status

Not yet implemented or released

Inputs

● Input: /humans/persons/tracked

Outputs

● Output: output?

Dependencies

● std_msgs/Empty

social_strategy_supervisor

The node social_strategy_supervisor (id: social_strategy_supervisor) is maintained by HWU.

Status

Not yet implemented or released

Inputs

Outputs

● Output: output?

Dependencies
INRIA

**basestation_republisher**

*The node basestation_republisher (id: basestation_republisher) is maintained by INRIA.*

**Status**

Implemented. Current release/branch: master

Source code repository: [https://gitlab.inria.fr/spring/wp3_av_perception/docker_republish](https://gitlab.inria.fr/spring/wp3_av_perception/docker_republish)

**Inputs**

- Input: /torso_front_camera/aligned_depth_to_color/image_raw/theora
- Topic subscription: /front_camera/fisheye/image_raw/compressed
  [sensor_msgs/CompressedImage]
- Input: /head_front_camera/color/image_raw/compressed
- Input: /torso_front_camera/color/image_raw/theora

**Outputs**

- Topic publication: /*_basestation/head_front_camera/...  [sensor_msgs/Image]
- Topic publication: /*_basestation/fisheye/...      [sensor_msgs/Image]

**Dependencies**

- std_msgs/Empty
- sensor_msgs/CompressedImage
- sensor_msgs/Image

**behavior_generator**

The code is primarily developed at INRIA by Timothée Wintz.

*The node behavior_generator (id: behavior_generator) is maintained by INRIA.*

**Status**
Implemented. Current release/branch: devel

Source code repository: https://gitlab.inria.fr/spring/wp6_robot_behavior/robot_behavior

Inputs

- Input: tf: /person_id (tf)
- Input: /joint_states
- Topic subscription: /rtabmap/proj_map [OccupancyGrid/OccupancyGrid]
- Topic subscription: /go_towards [GoTowards/GoTowards]
- Input: /h/g/tracked
- Input: /humans/persons/tracked
- Topic subscription: /navigate [Navigate/Navigate]
- Topic subscription: /look_at [LookAt/LookAt]
- Input: status

Outputs

- Topic publication: /head_controller/command [JointTrajectory/JointTrajectory]
- Topic publication: /nav_vel [Twist/Twist]
- Output: status
- Output: tf: ? (tf)

Dependencies

- JointTrajectory/JointTrajectory
- tf/transform_listener
- Twist/Twist
- std_msgs/Empty
- OccupancyGrid/OccupancyGrid
- GoTowards/GoTowards
- tf/transform_broadcaster
- Navigate/Navigate
- LookAt/LookAt

**body_3d_tracker**

_The node body_3d_tracker (id: body_3d_tracker) is maintained by INRIA._

**Status**

Implemented. Current release/branch: main

Source code repository: [https://gitlab.inria.fr/spring/wp3_av_perception/body_3d_tracker](https://gitlab.inria.fr/spring/wp3_av_perception/body_3d_tracker)

**Inputs**

- Topic subscription: /tracker/tracker_output [std_msgs/String]
- Topic subscription: /front_camera/fisheye/image_raw [sensor_msgs/Image]

**Outputs**

- Output: tf: /body_id (tf)
- Topic publication: /humans/bodies/tracked [hri_msgs/IdsList]

**Dependencies**

- tf/transform_broadcaster
- hri_msgs/IdsList
- std_msgs/String
- sensor_msgs/Image

**body_to_face_mapper**

_The node body_to_face_mapper (id: body_to_face_mapper) is maintained by INRIA._

**Status**

Implemented. Current release/branch: main

Source code repository: node associates detected bodies to detected faces in image-space.
REPO:[https://gitlab.inria.fr/spring/wp3_av_perception/body_to_face_mapper](https://gitlab.inria.fr/spring/wp3_av_perception/body_to_face_mapper)
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

**Inputs**

- Topic subscription: /humans/faces/TEST_ID_FACE/roi
  [hri_msgs/NormalizedRegionOfInterest2D]

- Topic subscription: /humans/bodies/<id>/roi
  [hri_msgs/NormalizedRegionOfInterest2D]

- Topic subscription: /humans/faces/tracked
  [hri_msgs/IdsList]

- Topic subscription: /humans/bodies/tracked
  [hri_msgs/IdsList]

**Outputs**

- Topic publication: /humans/candidate_matches
  [hri_msgs/IdsMatch]

**Dependencies**

- hri_msgs/IdsMatch
- hri_msgs/NormalizedRegionOfInterest2D
- hri_msgs/IdsList

**front_fisheye_2d_body_pose_detector**

This node estimates the 2.5D (x,y,theta) pose of nearby persons.

*The node front_fisheye_2d_body_pose_detector (id: front_fisheye_2d_body_pose_detector) is maintained by INRIA.*

**Status**

Implemented. Current release/branch: main

Source code repository: https://gitlab.inria.fr/spring/wp3_av_perception/front_fisheye_2d_body_pose_detector

**Inputs**

- Topic subscription: /front_camera/fisheye/image_raw
  [sensor_msgs/Image]

- Topic subscription: /tracker/tracker_output
  [std_msgs/String]

**Outputs**
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

- Topic publication: /humans/bodies/<id>/skeleton2D [hri_msg/Skeleton2D]

Dependencies
- sensor_msgs/Image
- hri_msg/Skeleton2D
- std_msgs/String

front_fisheye_body_tracker
2D body detector and tracker, based on the FairMOT algorithm. This code is primarily developed at INRIA by Luis Gomez Camara.

The node front_fisheye_body_tracker (id: front_fisheye_body_tracker) is maintained by INRIA.

Status
Implemented. Current release/branch: devel

Source code repository: https://gitlab.inria.fr/spring/wp3_av_perception/multi-person_visual_tracker/

Inputs
- Topic subscription: /front_camera_basetation/fisheye/image_raw/compressed [sensor_msgs/CompressedImage]

Outputs
- Topic publication: /humans/bodies/<id>/cropped [sensor_msgs/Image]

- Output:

- Topic publication: /tracker/tracker_output [std_msgs/String]

- Topic publication: /humans/bodies/<id>/roi [hri_msgs/NormalizedRegionOfInterest2D]

Dependencies
- sensor_msgs/CompressedImage
- sensor_msgs/Image
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

- std_msgs/Empty
- std_msgs/String
- hri_msgs/NormalizedRegionOfInterest2D

**go_to_body_action_server**

*The node go_to_body_action_server (id: go_to_body_action_server) is maintained by INRIA.*

**Status**

Not yet implemented or released

**Inputs**

- Input: goal
  - Topic subscription: /controller_status [ControllerStatus/ControllerStatus]

**Outputs**

- Topic publication: /go_towards [GoTowards/GoTowards]

**Dependencies**

- GoTowards/GoTowards
- std_msgs/Empty
- ControllerStatus/ControllerStatus

**go_to_group_action_server**

*The node go_to_group_action_server (id: go_to_group_action_server) is maintained by INRIA.*

**Status**

Not yet implemented or released

**Inputs**

- Input: goal
  - Topic subscription: /controller_status [ControllerStatus/ControllerStatus]

**Outputs**

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This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

- Topic publication: /go_towards [GoTowards/GoTowards]

## Dependencies
- std_msgs/Empty
- GoTowards/GoTowards
- ControllerStatus/ControllerStatus

### go_to_person_action_server

The node `go_to_person_action_server` (id: `go_to_person_action_server`) is maintained by INRIA.

**Status**

Not yet implemented or released

**Inputs**

- Topic subscription: /controller_status [ControllerStatus/ControllerStatus]
- Input: goal

**Outputs**

- Topic publication: /go_towards [GoTowards/GoTowards]

## Dependencies
- ControllerStatus/ControllerStatus
- GoTowards/GoTowards
- std_msgs/Empty

### go_to_position_action_server

The node `go_to_position_action_server` (id: `go_to_position_action_server`) is maintained by INRIA.

**Status**

Not yet implemented or released

**Inputs**
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

- **Input:** goal

- **Topic subscription:** `/controller_status` [ControllerStatus/ControllerStatus]

**Outputs**

- **Topic publication:** `/go_towards` [GoTowards/GoTowards]

**Dependencies**

- GoTowards/GoTowards
- std_msgs/Empty
- ControllerStatus/ControllerStatus

**group_detector**

*The node group_detector (id: group_detector) is maintained by INRIA.*

**Status**

Implemented. Current release/branch: main

Source code repository: https://gitlab.inria.fr/spring/wp4_behavior/group_detector

**Inputs**

- **Input:** `/h/p/tracked`
- **Input:** `tf`: `/body_id` (tf)

**Outputs**

- **Topic publication:** `/h/g/tracked` [hri_msgs/IdList]
- **Topic publication:** `/humans/group/<id>/` [hri_msgs/IdList]

**Dependencies**

- std_msgs/Empty
- hri_msgs/IdList
- tf/transform_listener
look_at_action_server

The node look_at_action_server (id: look_at_action_server) is maintained by INRIA.

Status
Not yet implemented or released

Inputs
- Input: goal
- Topic subscription: /controller_status [ControllerStatus/ControllerStatus]

Outputs
- Topic publication: /look_at [LookAt/LookAt]

Dependencies
- LookAt/LookAt
- std_msgs/Empty
- ControllerStatus/ControllerStatus

look_at_person_server

The node look_at_person_server (id: look_at_person_server) is maintained by INRIA.

Status
Not yet implemented or released

Inputs
- Input: goal
- Topic subscription: /controller_status [ControllerStatus/ControllerStatus]

Outputs
- Topic publication: /look_at [LookAt/LookAt]

Dependencies
● std_msgs/Empty
● LookAt/LookAt
● ControllerStatus/ControllerStatus

**look_at_position_action_server**

The node **look_at_position_action_server** (id: look_at_position_action_server) is maintained by INRIA.

**Status**

Not yet implemented or released

**Inputs**

- Input: goal
- Topic subscription: /controller_status [ControllerStatus/ControllerStatus]

**Outputs**

- Topic publication: /navigate [Navigate/Navigate]

**Dependencies**

- Navigate/Navigate
- std_msgs/Empty
- ControllerStatus/ControllerStatus

**slam_rtabmap**

The node **slam_rtabmap** (id: slam_rtabmap) is maintained by INRIA.

**Status**

This node is not yet implemented.

**Inputs**

- Input: torso_front_camera/infra/
- Input: /torso_front_camera/imu
Outputs

- Topic publication: /slam/occupancy_map  [OccupancyGrid/OccupancyGrid]
- Output: tf: /odom (tf)

Dependencies

- OccupancyGrid/OccupancyGrid
- std_msgs/Empty
- tf/transform_broadcaster

Other

PAL
dialogue_say

The node dialogue_say (id: dialogue_say) is maintained by PAL.

Status
Not yet implemented or released

Inputs

- Input: speech [std_msgs/String]

Outputs

- Output: /tts/feedback

Dependencies

- std_msgs/Empty

fisheye

The node fisheye (id: fisheye) is maintained by PAL.

Status
Not yet implemented or released
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

Inputs

Outputs

- Topic publication: /torso_front_camera/color/image_raw [sensor_msgs/Image]

Dependencies

- sensor_msgs/Image

**hri_person_manager**

*The node hri_person_manager (id: hri_person_manager) is maintained by PAL.*

**Status**

Implemented. Current release/branch: master

Source code repository: git@gitlab.inria.fr:spring/wp7_ari/hri_person_manager.git

**Inputs**

- Topic subscription: /humans/candidate_matches [hri_msgs/IdsMatch]

**Outputs**

- Output: /h/p/…
- Topic publication: /h/p/tracked [hri_msgs/IdsList]
- Output: tf: /person_id (tf)

**Dependencies**

- std_msgs/Empty
- hri_msgs/IdsList
- tf/transform_broadcaster
- hri_msgs/IdsMatch

**knowledge_core**

*The node knowledge_core (id: knowledge_core) is maintained by PAL.*
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

### Status

**Implemented. Current release/branch: 2.8.0**

**Source code repository:** [https://gitlab.inria.fr/spring/wp7_ari/knowledge_core](https://gitlab.inria.fr/spring/wp7_ari/knowledge_core)

### Inputs

- **Topic subscription:** `/kb/add_fact`  
  `[std_msgs/String]`

### Outputs

- **Output:** service: `/kb/query`

### Dependencies

- `std_msgs/String`
- `std_msgs/Empty`

### ORB SLAM

*The node ORB SLAM (id: orbslam) is maintained by PAL.*

**Status**

**Not yet implemented or released**

### Inputs

- **Topic subscription:** `/camera_torso/color/image_raw`  
  `[sensor_msgs/Image]`

### Outputs

- **Output:** tf: `/odom (tf)`
  
- **Topic publication:** `/map`  
  `[nav_msgs/OccupancyGrid]`

### Dependencies

- `tf/transform_broadcaster`
- `nav_msgs/OccupancyGrid`
- `sensor_msgs/Image`
people_facts

The node people_facts (id: people_facts) is maintained by PAL.

Status

Implemented. Current release/branch: 0.2.2

Source code repository: https://gitlab.inria.fr/spring/wp7_ari/people_facts

Inputs

- Input: /h/p/…

Outputs

- Topic publication: /kb/add_fact [std_msgs/String]

Dependencies

- std_msgs/Empty
- std_msgs/String

raspicam

The node raspicam (id: raspicam) is maintained by PAL.

Status

Not yet implemented or released

Inputs

Outputs

- Topic publication: /head_front_camera/color/image_raw [sensor_msgs/Image]

Dependencies

- sensor_msgs/Image

respeaker_ros

The node respeaker_ros (id: respeaker_ros) is maintained by PAL.

Status
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

Source code repository: git@gitlab.inria.fr:spring/wp7_ari/respeaker_ros.git
BIN: respeaker_multichan_node.py

Inputs

Outputs

- Topic publication: /audio/ego_audio [audio_common_msgs/AudioData]
- Topic publication: /audio/raw_audio [respeaker_ros/RawAudioData]

Dependencies

- audio_common_msgs/AudioData
- respeaker_ros/RawAudioData

Robot functional layer

The node Robot functional layer (id: robotfunctionallayer) is maintained by PAL.

Status

Not yet implemented or released

Inputs

- Input: input

Outputs

- Output: /joint_states

Dependencies

- std_msgs/Empty

spring_msgs

The node spring_msgs (id: spring_msgs) is maintained by PAL.

Status

Implemented. Current release/branch: 0.0.2
 Inputs

Outputs

torso_rgbd_camera

The node torso_rgbd_camera (id: torso_rgbd_camera) is maintained by PAL.

Status
Not yet implemented or released

Inputs

Outputs

- Output: torso_front_camera/infra/
- Output: /torso_front_camera/imu
- Topic publication: /torso_front_camera/color/image_raw [sensor_msgs/Image]

Dependencies

- std_msgs/Empty
- sensor_msgs/Image

UNITN

Activity reco

The node Activity reco (id: activityreco) is maintained by UNITN.

Status
This node is not yet implemented.

Inputs

- Topic subscription: /humans/bodies/<id>/skeleton_2d [hri_msg/Skeleton2D]

Outputs
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

**Output**: [?] output

**Dependencies**

- hri_msg/Skeleton2D
- std_msgs/Empty

---

**depth_estimation**

*The node depth_estimation (id: depth_estimation) is maintained by UNITN.*

**Status**

Implemented. Current release/branch: main

Source code repository: https://gitlab.inria.fr/spring/wp4_behavior/depth-estimation

**Inputs**

- Topic subscription: /head_front_camera/color/image_raw/compressed [sensor_msgs/CompressedImage]

**Outputs**

- Topic publication: /depth_estimation [sensor_msgs/Image]

**Dependencies**

- sensor_msgs/CompressedImage
- sensor_msgs/Image

---

**gaze_estimation**

This node uses deep learning to estimate, on a given frame, the focus of attention of a detected face. It outputs the 2D coordinate of the most likely focus of attention, in the image space.

*The node gaze_estimation (id: gaze_estimation) is maintained by UNITN.*

**Status**

Implemented. Current release/branch: devel

Source code repository: https://gitlab.inria.fr/spring/wp4_behavior/gaze-estimation

**Inputs**
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

**Topic subscription:** /depth_estimation [sensor_msgs/Image]

**Topic subscription:** /humans/faces/TEST_ID_FACE/roi [sensor_msgs/RegionOfInterest]

### Outputs
- Output: GazeFrame [2D point in heatmap]

### Dependencies
- std_msgs/Empty
- sensor_msgs/Image
- sensor_msgs/RegionOfInterest

**mask_detector**

Detects presence of a facial mask

*The node mask_detector (id: mask_detector) is maintained by UNITN.*

**Status**

Implemented. Current release/branch: master

**Source code repository:** [https://gitlab.inria.fr/spring/wp4_behavior/mask-detection](https://gitlab.inria.fr/spring/wp4_behavior/mask-detection)

**BIN:** mask_detector.py

### Inputs
- **Topic subscription:** /*_basestation/head_front_camera/... [sensor_msgs/Image]

### Outputs
- **Topic publication:** /humans/faces/TEST_ID_FACE/cropped [sensor_msg/Image]
- **Topic publication:** /humans/faces/TEST_ID_FACE/has_mask [wp4_msgs/FaceMask]
- **Topic publication:** /humans/faces/tracked [hri_msgs/IdsList]
This project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 871245.

● Topic publication: /humans/faces/TEST_ID_FACE/roi
  [hri_msgs/NormalizedRegionOfInterest2D]

Dependencies

● sensor_msg/Image
● sensor_msgs/Image
● wp4_msgs/FaceMask
● hri_msgs/IdsList
● hri_msgs/NormalizedRegionOfInterest2D

Non-verbal behaviours

The node Non-verbal behaviours (id: nonverbalbehaviours) is maintained by UNITN.

Status

This node is not yet implemented.

Inputs

● Topic subscription: /humans/faces/TEST_ID_FACE/roi
  [hri_msgs/RegionOfInterest]

● Topic subscription: /humans/voices/<id>/raw_audio
  [spring_msgs/RawAudioData]

Outputs

● Topic publication: /humans/faces/TEST_ID_FACE /expression
  [hri_msgs/Expression]

Dependencies

● hri_msgs/Expression
● hri_msgs/RegionOfInterest
● spring_msgs/RawAudioData

soft_biometrics_estimator
The node soft_biometrics_estimator (id: soft_biometrics_estimator) is maintained by UNITN.

Status

Implemented. Current release/branch: master

Source code repository: git@gitlab.inria.fr:spring/wp4_behavior/wp4_behavior_understanding.git

Inputs

- Topic subscription: /head_front_camera/color/image_raw/compressed [sensor_msgs/CompressedImage]
- Topic subscription: /humans/faces/tracked [hri_msgs/IdsList]

Outputs

- Topic publication: /humans/candidate_matches [hri_msgs/IdsMatch] [face reco/face reco]
- Topic publication: /humans/faces/TEST_ID_FACE/softbiometrics [hri_msgs/SoftBiometrics]

Dependencies

- face reco/face reco
- sensor_msgs/CompressedImage
- hri_msgs/IdsList
- hri_msgs/SoftBiometrics

User attention estimation

The node User attention estimation (id: userattentionestimation) is maintained by UNITN.

Status

This node is not yet implemented.

Inputs

- Input: TF (faces)
● Topic subscription: /humans/faces/TEST_ID_FACE/roi [hri_msgs/RegionOfInterest]

Outputs

● Output: tf: /face_id_gaze (tf)
● Output: x,y + attention heatmap

Dependencies

● std_msgs/Empty
● tf/transform_broadcaster
● hri_msgs/RegionOfInterest

User visual focus

*The node User visual focus (id: uservisualfocus) is maintained by UNITN.*

Status

This node is not yet implemented.

Inputs

● Input: gaze direction
● Input: depth
● Input: scene
● Input: attention

Outputs

● Topic publication: /humans/interactions/gaze [hri_msgs/Gaze]
● Output: who's looking at what?

Dependencies

● std_msgs/Empty
**Non-executable dependency: audio_msgs**
Module audio_msgs (id: audio_msgs) is overseen by HWU.

**Status**
- Current release: spring_dev

**Dependencies**

**Non-executable dependency: hri_msgs**
Module hri_msgs (id: hri_msgs) is overseen by PAL.

**Status**
- Current release: 0.1.1

**Dependencies**

**Non-executable dependency: interaction_manager_msgs**
Module interaction_manager_msgs (id: interaction_manager_msgs) is overseen by HWU.

**Status**
- Current release: spring_dev

**Dependencies**

**Non-executable dependency: robot_behaviour_msgs**
Module robot_behaviour_msgs (id: robot_behaviour_msgs) is overseen by HWU.

**Status**
- Current release: spring_dev

**Dependencies**

**Non-executable dependency: social_scene_msgs**
Module social_scene_msgs (id: social_scene_msgs) is overseen by HWU.

**Status**
Dependencies

Non-executable dependency: wp4_msgs

Module wp4_msgs (id: wp4_msgs) is overseen by UNITN.

Status

- Current release: master

Dependencies
CONCLUSIONS

The final software architecture including the complete SW developed within the project will be reported in the D7.5.