



ROBOTS IN ASSISTED LIVING ENVIRONMENTS

UNOBTRUSIVE, EFFICIENT, RELIABLE AND MODULAR SOLUTIONS FOR INDEPENDENT AGEING

Research Innovation Action

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DELIVERABLE 3.9

Integrated data analysis system I

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Abstract

This deliverable demonstrates the integrated ADL recognition stack.

History and Contributors

Ver	Date	Description	Contributors
01	1 Jun 2016	First draft, establishing document structure.	NCSR-D
02	17 Jun 2016	Integrated prototype deployed at FSL trials.	NCSR-D and TWG
03	5 April 2017	Updated prototype with latest components in D3.4. Prepared virtual machine demonstration.	NCSR-D
04	11 April 2017	Final version given for review	TWG and NCSR-D
05	12 April 2017	Internal review comments and corrections	ROBOTNIK
Fin	12 April 2017	Final document preparation and submission	NCSR-D



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1 INTRODUCTION

1.1 Purpose and Scope

This deliverable is an integrated ROS stack for ADL recognition. This stack comprises the prototype implementations of the ADL recognition methods developed in T3.2. The technical description and the explanation of the methodological advances that these prototypes demonstrate is documented in D3.4: *ADL and mood recognition methods I*.

Within the scope of this deliverable is the ROS-compatible versions of the method prototypes and auxiliary software needed for integration (Section 2), and the demonstration of the operation of the integrated stack (Section 3).

The robot prototype and other software needed for the operation of the robot (not directly related to ADL recognition) is out of scope and will be developed in Task 4.3 *Robotic platform design and integration* and demonstrated in D4.6 *Integrated Robotic Platform I*. The overall RADIO Home and software needed for fusing the outputs ADL recognition methods, including fusing with home automation sensor data, is also out of scope and will be developed in Task 4.4 *Smart home design and integration* and demonstrated in D4.8 *Integrated smart home with robotic platform extensions*.

1.2 Approach

This deliverable is the result of integrating the prototypes of the sensor data analysis methods into a software system using the ROS middleware as a basis. The design of the pipelines and interconnections between the components aims at providing the modularity needed in order to:

- Have explicit and minimal dependencies, so that the system can be partially installed to satisfy the different clinical and obtrusiveness requirements that each deployment needs to meet;
- Have the modularity that allows executing different modules either near the sensors (e.g., on-board the robot) or at more central computational infrastructures (e.g., a home computer), allowing different configurations to address different needs on battery autonomy, on-board computational power, network bandwidth, and the transmission of sensitive raw content.

This integrated prototype is a software prototype, not addressing its embedding in the RADIO hardware architecture which is the focus of WP4.

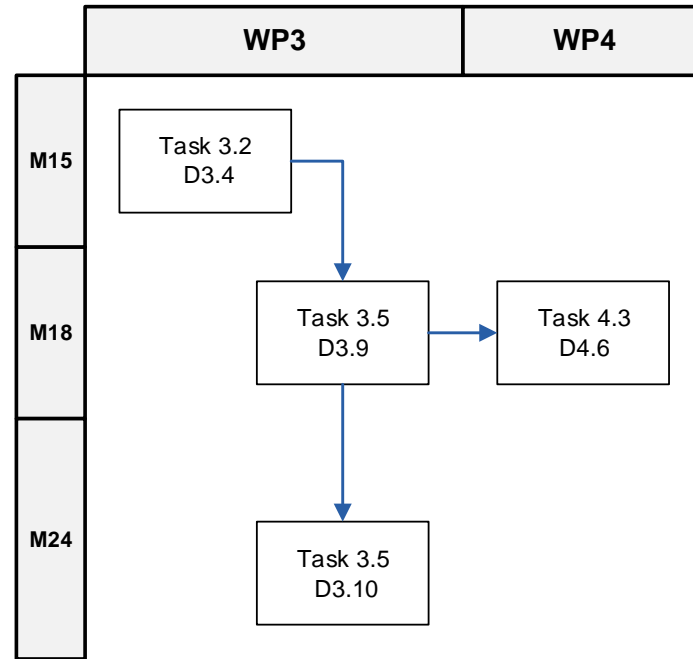


Figure 1: Relation to other Work Packages and Deliverables

1.3 Relation to Other Work Packages and Deliverables

This document is part of a cluster of closely related deliverables. The initial conceptual architecture (D3.1) planned development in Task 3.2 until M18, including a first overview of the state of the art upon which RADIO development was based. In this version, all methodological information has been moved to D3.4 *ADL and mood recognition methods* and this document only retains the architectural design and component interconnections needed to satisfy the user requirements (WP2) and the findings of D3.6 *Network robustness and efficiency methods*.

In this manner, work around ADL and Mood recognition is organized as follows:

- D3.2 *Conceptual architecture II* (R): design and interconnections of components
- D3.4 *ADL and mood recognition methods I* (R): methods developed in order to implement the components specified in D3.2
- D3.9 *Integrated data analysis system I* (DEM): this deliverable.

Finally, this deliverable is used by Task 4.3 to prepare the robot prototype (D4.6).

2 PROTOTYPE

The following software is the result of integrating in ROS method prototypes from D3.4:

Description	Source code repository and release used for this deliverable
HumanPatterRecognition: Recognizes human walking patterns in laser scans and tracks walking [D3.4, Section 2].	https://github.com/radio-project-eu/HumanPatternRecognition v2.0
ROSVISual: Tracks moving objects in the RGB/depth modality [D3.4, Section 3].	https://github.com/radio-project-eu/ros_visual v2.0
Motion Analysis: Recognizes motion and classifies it as “bed transfer” and “pill intake” events [D3.4, Section 4].	https://github.com/radio-project-eu/motion_analysis v1.2
Simple Motion Analysis/FPGA: Re-implementation of the motion analysis above without using the OpenCV library. This version is better suited to FPGA optimization.	https://github.com/radio-project-eu/simple-visual-events master branch

The following auxiliary software was developed for D3.9 to facilitate the integration of the outputs of the components above:

Description	Source code repository and release used for this deliverable
HPR Wrapper: Uses HPR output to recognize and time “walked 4m” events.	https://github.com/radio-project-eu/HumanPatternRecognition v2.0
Motion Analysis: Uses motion analysis output to time the bed transfer event.	https://github.com/radio-project-eu/motion_analysis_wrapper v1.0

The following auxiliary software is not part of the ADL recognition stack, but is part of the solution and is needed for deployment and configuration:

Description	Source code repository and release used for this deliverable
Motion Analysis: Technicians’ interface for motion analysis configuration. This is implemented as a separate ROS node that publishes configuration packages to the main motion analysis node that implements the method.	https://github.com/radio-project-eu/motion_analysis v1.2

3 DEMONSTRATION

The ADL recognition stack in this deliverable is demonstrated as a virtual machine in OVA format and can be downloaded at <http://hdl.handle.net/21.15101/11>

The downloaded OVA needs to be imported to VirtualBox [<https://www.virtualbox.org>] or similar virtualization software. The OVA appliance includes an Ubuntu 14.04 LTS and ROS/Indigo installation, the prototypes, and sample recordings from the RADIO Dataset (cf. D3.5, Section 2.2), so that the demonstration does not rely on downloading the complete dataset.

Once the virtual machine boots, it logs in without a password. The demonstration starts by opening a terminal and executing the script called “run”

The demonstration opens a new window to show the video recording, while the recognized events are printed in the terminal where “run” executes.