



Project SPENCER: Factsheet

SPENCER project in short

Title: Social situation-aware perception and action for cognitive robots

Acronym: SPENCER

Beneficiaries: 8 partners: 6 university and 2 industrial partners from 5 European countries

Total budget: 4,274,181 €

EC funding: 3,179,933 €

Project ID: 600877

Project Type: STREP

Call: FP7 ICT 2011-9

Duration: 1 April 2013 – 31 March 2016, 36 months

Project Website: <http://www.spencer.eu>

Press Material: <http://www.spencer.eu/press.html>

Abstract

SPENCER is an EU-funded research project that advances technologies for intelligent robots that operate in human environments. Such robots come in different sizes and shapes: guidance platforms at airports, domestic household aids, care-takers for the elderly, collaborative production assistants in factories, or self-driving cars. Common to all of them is the need for new technologies that address questions such as: how should machines perceive and analyze humans with their sensors in order to act more naturally and unobtrusively? How can they learn and reproduce human social behavior? How should robots reason about actions among humans and communicate with users in ways that are socially-aware, safe, and efficient at the same time? By addressing these questions jointly and in an international multi-disciplinary team, the SPENCER consortium breaks new ground for understanding human-robot relationships and for designing effective cognitive systems in human-populated spaces.

Demonstration at Schiphol Airport

KLM, the end-user in the consortium, believes that robotics will have a growing impact on air transport in the coming years. One example for which the technologies developed in SPENCER are highly relevant is the area of ground passenger services. At their home base Schiphol Airport, up to 80% of passenger traffic is due to transfer passengers whose efficient handling is a significant operational challenge. Every day, travellers miss their connecting flights for all sorts of reasons, including delays, short transfer times, losing their way, and language barriers. To help these people, SPENCER guides transfer passengers along the

shortest route to their departure gate. This use-case is relevant for KLM and it is also an excellent benchmark to evaluate the scientific research in SPENCER given the challenging nature of airports as highly populated environments.

SPENCER Robot

The SPENCER robot was designed, built and integrated during the project.

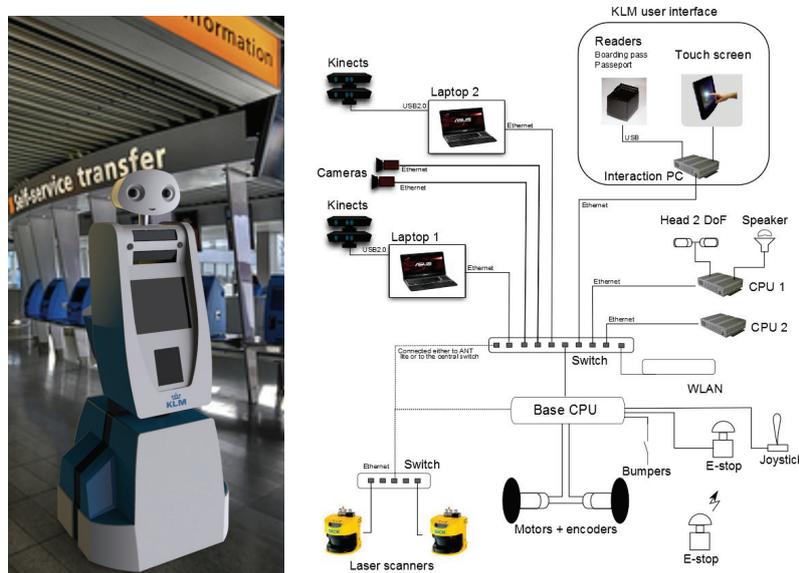


Figure 1: Design and Hardware Architecture

- **Height:** 193 cm
- **Weight:** 250 kg
- **Maximal speed:** 1.8 m/s
- **Maximal speed at the airport:** 1.3 m/s
- **Sensors:** two 2D laser scanners, one 3D laser scanner, four ASUS Xtion depth cameras (like MS Kinect), two cameras (stereo vision), tactile bumpers
- **Interaction modalities:** Head with two degrees of freedom (pan, tilt), eyes with one degree of freedom (pan), 17" touch screen, KLM boarding pass and passport reader, loudspeakers
- **Payload:** mountable container to carry one to two hand luggage items
- **Locomotion:** two wheels, differential drive kinematics
- **On-board computers:** two high-performance laptops (Linux), three PCs (2x Linux, 1x Windows), one motion controller (Real-time OS), ROS middleware.
- **Languages:** The robot communicates in English (new languages can be programmed easily)

Description of project partners and their role

1. Albert-Ludwigs-Universität Freiburg, Germany (Coordinator, ALU-FR)

The Social Robotics Laboratory (SRL) within the Computer Science Department of the University of Freiburg is headed by Prof. Dr. Kai Arras. The lab is concerned with technologies for perception, learning, estimation, and planning in the context of socially enabled cognitive systems. Within SPENCER, SRL develops technologies for detecting, tracking and analyzing people and groups of people as well as learning human behavior models for socially-aware motion and interaction planning. Prof. Arras is the project coordinator of SPENCER.

Competences Related to SPENCER: Range-based people and group detection and tracking (WP4, WP3), Perception and learning (WP2, WP4), Human activity modeling (WP5), System specification and integration (WP1), Management (WP8)

2. Technische Universität München, Germany (TUM)

The TUM Computer Vision Group, headed by Prof. Dr. Daniel Cremers, is focused on a range of topics in computer vision, image analysis and pattern recognition. Over the years, the group has developed novel convex optimization methods to solve a number of problems including image segmentation, image denoising, image-based 3D reconstruction, shape matching and optical flow estimation.

Competences Related to SPENCER: Unsupervised object detection (WP2), Online estimation of dynamic objects (WP2), 3D mapping and SLAM (WP2).

3. Universiteit Twente, The Netherlands (UT)

The Human Media Interaction group, headed by Prof. Dr. Vanessa Evers, is part of Computer Science Department. The focus of the group is on intelligent multimodal human computer interaction.

Competences Related to SPENCER: Social signal processing (WP2), Human-robot interaction (WP4 and WP6), User experience evaluation (WP4 and WP6), Cross-cultural human robot interaction (WP4 and WP6).

4. Örebro University, Sweden (ORU)

The AASS Mobile Robotics and Olfaction Lab, headed by Prof. Achim J. Lilienthal, has a focus on perception systems for mobile robots that operate in an unconstrained, dynamic environments. The developed approaches typically address real-world needs and are characterized by fusion of different sensory modalities. In addition to the scientific activities, the group is interested in transferring research results into industrial demonstrators.

Competences Related to SPENCER: SLAM and navigation in dynamic environments (WP2), Semantic mapping (WP2), Navigation (WP5), 3D perception (WP2).

5. Centre National de la Recherche Scientifique CNRS, France (CNRS)

The Laboratoire d'Analyse et d'Architecture des Systemes (LAAS) is a laboratory of CNRS, the French National Organisation for Scientific Research. Within CNRS-LAAS, the Robotics and Artificial Intelligence Department, the largest in France, is active in research on intelligent and autonomous robotic systems. The team is composed of members from the Robotics and Interactions Group. The Institut des Systèmes Intelligents et de Robotique (ISIR) is a research lab of the Université Pierre et Marie Curie (UPMC), associated to the CNRS. ISIR is a multidisciplinary research laboratory, which gathers disciplines of engineering and computer science including mechanics, automation, signal processing, computer science, and neuroscience. The team is composed of members from the AMAC and INTERACTION teams.

Competences Related to SPENCER: Human-aware motion planning (WP5), Decisional issues in human-robot interaction (WP5), Architectures for cognitive and interactive robots (WP1 and WP5), Software system specification and integration (WP6).

6. Rheinisch-Westfälische Technische Hochschule Aachen, Germany (RWTH)

RWTH is represented by the Computer Vision group headed by Prof. Dr. Bastian Leibe, which is part of the Visual Computing Institute. The group is focusing on computer vision applications for mobile devices and robotics platforms and has gained substantial experience in visual object categorization, tracking, and in the interface between recognition and 3D reconstruction. Particular emphasis is placed on real-world applicability of the developed algorithms, which is an important prerequisite for robotics applications.

Competences Related to SPENCER: Computer vision (WP2 and WP3), Object recognition (WP2), Visual tracking (WP2), Figure-ground segmentation (WP3), Body pose estimation and articulated tracking (WP3).

7. BlueBotics SA, Switzerland (BLUE)

BlueBotics SA is a spin-off company of the Autonomous Systems Lab, EPFL. Founded in 2001 with the mission to market innovative and promising mobile robotics technologies, the company is now active in two segments based on autonomous navigation solutions:

Automation and service robotics. With its portfolio, BlueBotics SA belongs to the most experienced companies in Europe when it comes to the specification, design and deployment of complex interactive robots in real-world environments.

Competences Related to SPENCER: Robot design (WP1), System integration (WP1), Exploitation and technology transfer (WP7), Robot navigation (WP5).

8. KLM Royal Dutch Airlines, The Netherlands (KLM)

KLM Royal Dutch Airlines is a worldwide airline company based in the Netherlands. KLM operates worldwide scheduled passenger and cargo services to more than 90 destinations. It is the oldest airline in the world still operating under its original name and has around 33,000 employees. It comprises the core of the KLM Group, which further includes KLM Cityhopper, transavia.com and Martinair. KLM works very closely with Air France within the AIR FRANCE KLM Group, which exists since the two companies merged in 2004. The AIR FRANCE KLM Group is Europe's leading Group in the Airline business.

Competences Related to SPENCER: Aviation industry end-user (WP1), Exploitation, public relations and dissemination (WP7).

Work Plan Structure

The project's work plan is divided into eight work packages:
(see www.spencer.eu/project.html for more details)

	Description	Respons.
WP1	Requirement Analysis, Platform Specification and Design	BLUE
WP2	Far-Range Perception: People and Object Analysis	TUM
WP3	Close-Range Perception: Human Attribute Analysis	RWTH
WP4	Group-Level Analysis and User Studies	UT
WP5	Behavior Learning and Planning	ALU-FR
WP6	System Integration, Deployment, and Evaluation	CNRS
WP7	Dissemination and Exploitation	ORU
WP8	Management	ALU-FR

Contact

Spencer consortium:

Kai Arras (Coordinator, ALU-FR) – arras@cs.uni-freiburg.de – +49 173 7390728

Rudolph Triebel (Scientific Manager, TUM) – rudolph.triebel@in.tum.de – +49 172 7568740

Vanessa Evers (UT) – v.evers@utwente.nl

Achim J. Lilienthal (ORU) – achim.lilienthal@oru.se

Mohamed Chetouani (CNRS) – mohamed.chetouani@upmc.fr

Bastian Leibe (RWTH) – leibe@vision.rwth-aachen.de

Patrick Balmer (BLUE) – patrick.balmer@bluebotics.com

KLM project members:

Ruben Alblas – ruben.alblas@klm.com – +31 61 0376515

Laila Ben Salah – laila.bensalah@klm.com – +31 61 3980165

Lisette Ebeling-Koning – lisette.ebeling-koning@klm.com – +31 61 0619062