

# TACO

Three-dimensional  
Adaptive Camera  
with Object  
Detection  
and Foveation

Project Number: **248623**  
Project Website: **[www.taco-project.eu](http://www.taco-project.eu)**  
Project start: **February 1, 2010**  
Project duration: **3.5 years**  
Total Costs: **€ 4.791.835.-**  
EC-Contribution: **€ 3.572.000.-**



Project is co-financed by the European Commission (under Seventh Framework Programme)





## Mission of TACO:

To enhance the abilities of service robots by improving the sensing system with real 3D foveation properties.

To develop a three dimensional sensing system with real 3D foveation properties to increase the ability for the service robot interaction with their natural environment.

To develop a three dimensional sensing system with real 3D foveation properties to allow robots to interact with everyday environment in a more natural and human-like manner.

## Motivation:

The area of robotics is an innovative and growing industry. Currently service robots are adopted to execute works which are dull, dangerous, dirty or dumb. Within the further development of service robots, their functionalities are extended and therefore they can fulfil more sophisticated tasks (e.g. in the fields of cleaning, construction, maintenance, security, health care, entertainment and personal assistance).

A novel 3D sensing system (fast, small, lightweight and relatively energy-efficient) will be produced by the TACO project which includes the following three points:

- › A novel concept for fast attention level management based on the 3D foveation principle enabled by dedicated sensor hardware.
- › A 3D laser scanner sensor based on a miniaturised micro-mirror device combined with time-of-flight measurement technology, which will enable operation in different modes ranging from coarse broad field-of-view 3D image acquisition to higher resolution narrow field-of-view 3D image acquisition.
- › A software framework for fast object detection in everyday scenes based on saliency and visual cues. These cues allow efficient selection of details of interest, controlling the foveation process of the 3D sensing device.

The goal of TACO will be a flexible, compact, robust and low cost 3D image acquisition device providing high resolution, high quality data for robot real-time operations.



## Objectives:

The main objective of the TACO project is the development of a 3D sensing system with real 3D foveation properties endowing service robots with a higher level of motion and affordance perception and interaction capabilities with respect to every day objects and environments. Advantages of the developed project compared to the state-of-the-art systems will be

- › at least 10 times better spatial and/or temporal resolution of detected details of interest
- › a 10 times smaller and cheaper 3D laser scanner

TACO pursues three scientific and technological (S&T) as well as three market and outreach (M&O) objectives:

**S&T Objective 1:** flexible, compact, robust and low cost 3D imaging device.

**S&T Objective 2:** achievement of 3D measurements of increased spatial and temporal resolution in detected regions-of-interest.

**S&T Objective 3:** benchmarking of the 3d sensing system on robots in an everyday environment test bed including interaction with everyday objects

**M&O Objective 1:** new technology to the European robotics industry.

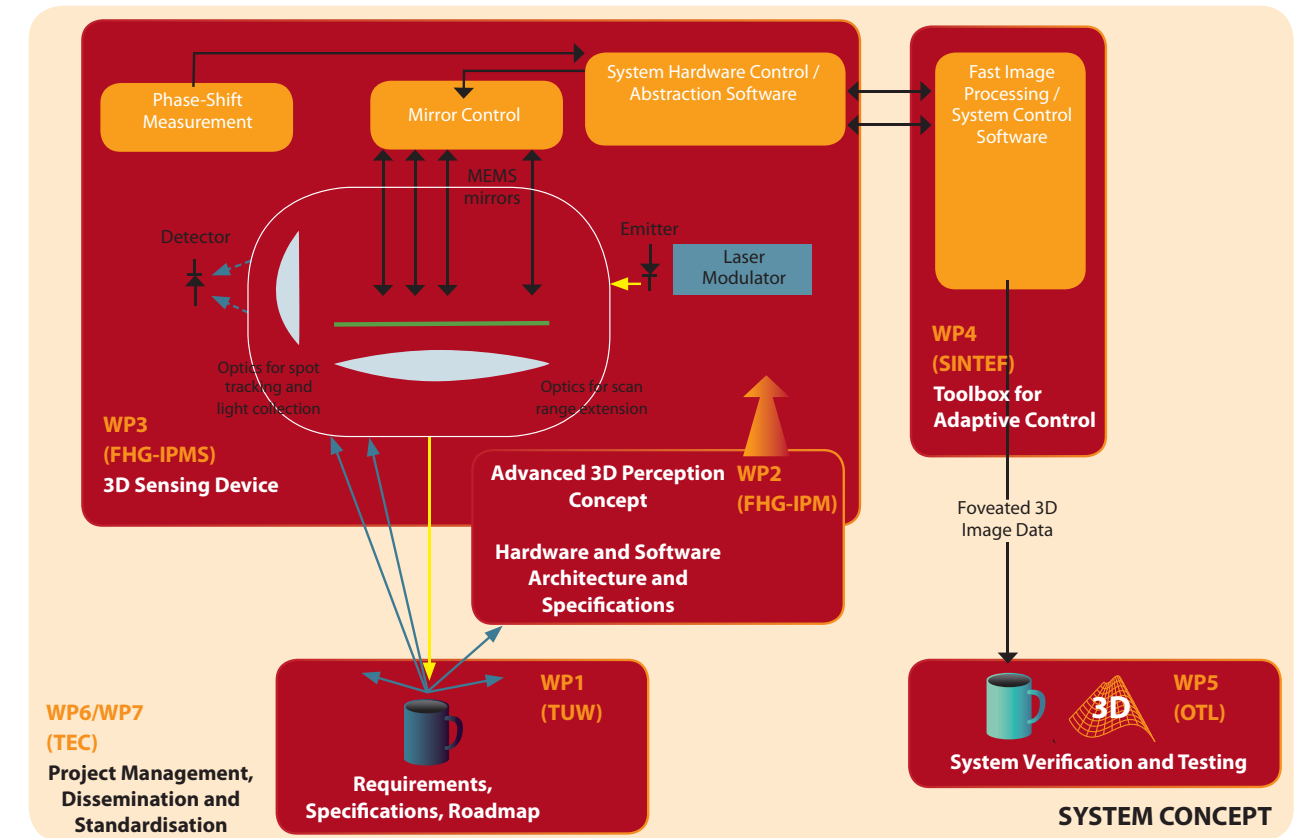
**M&O Objective 2:** making TACO knowledge visible within industry and the scientific community.

**M&O Objective 3:** carry out proof-of-concept validation of the concept.

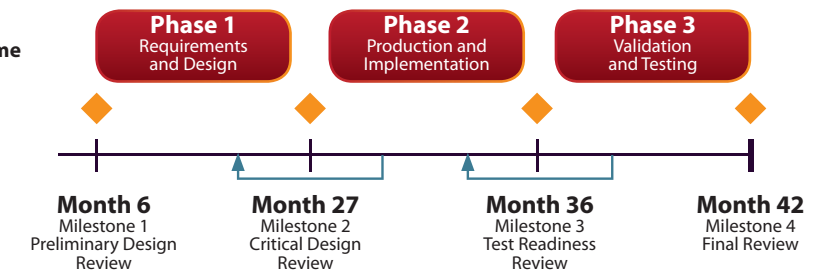
## Overall Strategy:

The TACO project is divided into three main phases:

- › **Phase 1** – Requirements & Design:  
Milestone 1: Preliminary Design Review (Month 6)  
Milestone 2: Critical Design Review (Month 27)
- › **Phase 2** – Production & Implementation:  
Milestone 3: Test Readiness Review (Month 36)
- › **Phase 3** – Validation & Testing:  
Milestone 4: Final Review (Month 42)



## Phases of TACO work programme



## Technical Approach:

The development of the project will be organised in seven work packages:

- WP1:** Requirements, Specification and Roadmap: achieves a common specification of the camera and details the project roadmap for the following work packages.
- WP2:** Advanced 3D perception concept: includes the performance evaluation and concept studies of critical technologies and design decisions of the necessary camera components.
- WP3:** 3D sensing device: builds and assembles the actual camera hardware.
- WP4:** Toolbox for adaptive control: delivers a software package for the functionalities of the camera.
- WP5:** System verification and Testing: benchmarks and tests the developed sensor.
- WP6:** Dissemination, Exploitation and Standardisation
- WP7:** Project management

## Project Results and Innovation:

The project covers the whole value chain within 3D sensing systems with partners specialising in MEMS hardware components, time-of-flight sensors, 3D image analysis software algorithms and robotic industry applications.

A 3D sensing system based on miniaturised Silicon MEMS-based technology can be incorporated in small units mountable as payload on both service robots or on the arm of an industrial robot. The development of a 3D sensing system will fasten the research in the robotic fields of 3D attention awareness management and strategies for fast acquisition of images. Furthermore the reliable 3D sensing systems of TACO will pave the way for a much broader deployment of robots for various applications. Thus, there will be worldwide market opportunities open for sensor hardware and software application producers based on the principles of 3D foveation.

## Contact:

### Project Coordinator

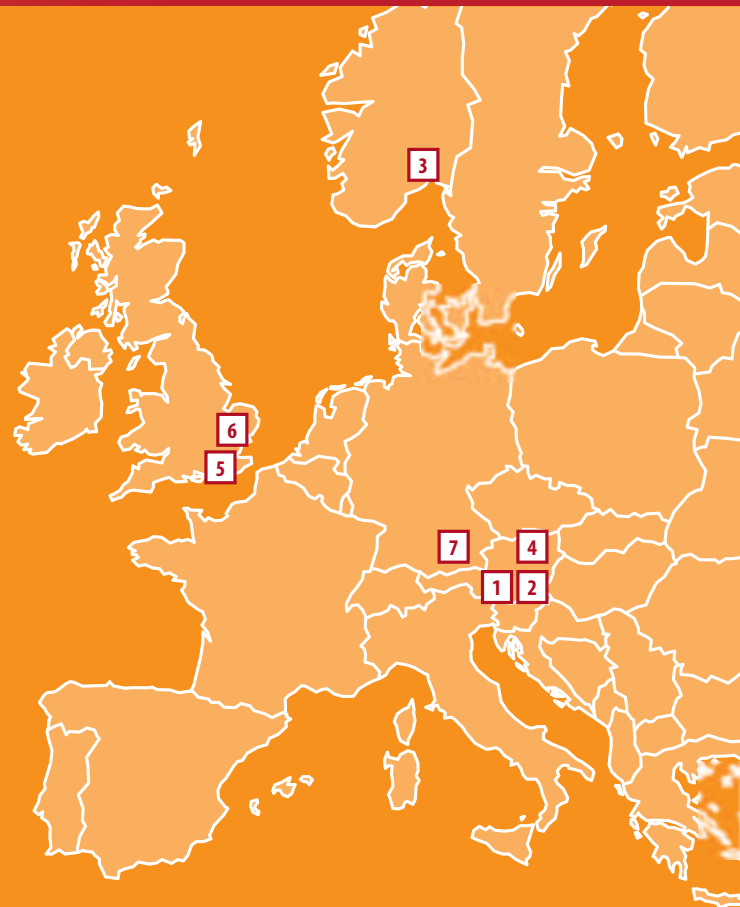
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## Consortium:

Seven European Organisations (four research institutes, two industrial companies and one university, which are seated in four different countries: Austria, UK, Germany and Norway) are member of the TACO consortium. The project partners' expertises cover the fields of robotics and sensors as well as process design experience.



## Project Partners:

The consortium is constituted of 7 partners from 4 different countries:



Technikon Forschungs- und Planungsgesellschaft mbH (Austria)



CTR AG, F&E Zentrum für Sensorik (Austria)



Stiftelsen SINTEF (Norway)



TU Wien (Austria)



Oxford Technologies (UK)



Shadow Robot Company (UK)



Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (Germany)