European Union's Seventh Framework Programme for Research and Technological Development
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Cognitive Systems and Robotics

Projects resulting from the fourth FP7-ICT Call for Proposals– 2009

Summaries

January 2010

Foreword: This is a list of projects resulting from the FP7-ICT fourth Call for Proposals. Summaries have been edited for space reasons and funding figures are approximate. Use of contents is at the recipient's own responsibility. For further information visit the EU's Cognitive Systems, Interaction and Robotics website at http://cordis.europa.eu/fp7/ict/cognition/home_en.html

AIROBOTS

ICT Call: FP7-ICT-2009-4
ID: 248669 - AIRobots
Title: Innovative aerial service robots for remote inspections by contact
Duration: 36 months
Funding: 2,616 Keuros

Summary

The goal of AIRobots is to develop a new generation of aerial service robots capable to support human beings in activities which require a robot to be able to interact actively and safely with environments, not being constrained to the ground but, indeed, operating freely in the air. The step forward, with respect to the classical field of aerial robotics, is to develop aerial vehicles able to handle a wide variety of applications, such as inspection of buildings and large infrastructures, picking of environmental samples, aerial remote manipulation, etc.

The starting point for the project is an aerial platform whose aeromechanical configuration allows the vehicle to interact with the environment in a non-destructive way and to hover close to operating points. Rotary-wing aerial vehicles with shrouded propellers comprise the basic airframes which will be then equipped with appropriate robotic end-effectors and sensors in order to transform the platform into an aerial service robot, i.e. a system able to fly and to achieve robotic tasks.

Advanced automatic control algorithms will be conceived to govern the aerial platform, which will be remotely supervised by the operator through the use of haptic devices. Particular emphasis will be put on developing advanced human-in-the-loop and autonomous navigation control strategies relying upon a cooperative and adaptive interaction between the on-board automatic control and the remote operator. Force- and visual feedback strategies will be investigated in order to transform the aerial platform into a “flying hand” suitable for aerial manipulation.

Prototypes of aerial service robots will be developed and tested in industrial scenarios, on tasks such as docking and undocking from structures, cleaning, inspection and repair of infrastructures, payload lifting and other operations requiring safe interaction between the aerial platform and the environment.

Co-ordinator: Prof. Lorenzo Marconi, ALMA MATER STUDIORUM-UNIVERSITA DI BOLOGNA, IT

Participants:

ALSTOM Inspection Robotics	CH
Eidgenössische Technische Hochschule Zürich	CH
UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II.	IT
UNIVERSITEIT TWENTE	NL

ALIZ-E

ICT Call: FP7-ICT-2009-4.
ID: 248116 - ALIZ-E
Title: Adaptive Strategies for Sustainable Long-Term Social Interaction
Duration: 54 months
Funding: 8,287 Keuros

Summary

ALIZ-E aims to develop methods for developing and testing interactive, mobile robots which will be able to interact with human users over extended periods of time; in other words, aiming at a possibly non-continuous succession of interactions which can refer back to, and build forth on, previous experiences.

To achieve this aim, ALIZ-E will address three related issues: how long-term experience can be acquired to ground actions and interactions across time; how a system can deal robustly with inevitable differences in quality in perceiving and understanding a user and her environment; how a system can adapt its interaction based on the way user behaviour changes over time and in different contexts. To demonstrate and evaluate the scientific methods, ALIZ-E will instantiate and evaluate these methods in working systems which interact with hospitalized children undergoing diabetes treatment. Long-term interaction in this context means interactions over a period of up to 5 days and possibly longer. By choosing this scenario, ALIZ-E makes it possible to bring extensive experience in conducting clinical trials of IT technology to the field of cognitive systems and human-robot interaction, and to help develop novel methods for evaluating interactive robots at system-level.

The main impact will be on theoretical cognitive systems research (e.g. memory, long-term affective interaction), implementation (e.g. adaptive deployment of processing and behaviour for robust interaction, cloud computing for cognitive systems, speech processing for young users) and commercial applications.

Co-ordinator: Dr. Tony Belpaeme, UNIVERSITY OF PLYMOUTH, UK

Participants:

DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH	DE
VRIJE UNIVERSITEIT BRUSSEL	BE
NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO	NL
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	UK
THE UNIVERSITY OF HERTFORDSHIRE HIGHER EDUCATION CORPORATION	UK
FONDAZIONE CENTRO SAN RAFFAELE DEL MONTE TABOR	IT
CONSIGLIO NAZIONALE DELLE RICERCHE	IT
Gostai S.A.S.	FR

AMARSI

ICT Call: FP7-ICT-2009-4
ID: 248311 - AMARSi
Title: Adaptive Modular Architecture for Rich Motor Skills
Duration: 48 months
Funding: 6,998 Keuros

Summary

Compared with animals and humans, the motor skills of today's robots still must be regarded as poor. AMARSi aims at making a qualitative leap towards achieving biological richness in robotic motor skills. The project will address:

- coordinated and simultaneous development of compliant mechanics, pervasive learning and dynamical-systems based control architectures;
- mutually informed research in human motor behaviour and robotics;
- reliance on compliant mechanics and morphological computing for flexibility, computational and motoric speed, safety and damage-robust learning;
- novel learning paradigms drawing from principles of reservoir computing;
-control architectures based on dynamical (neural) systems throughout, also on the higher cognitive levels, etc.

Robotic demonstration will be based on a compliant version of the iCUB robot and a compliant quadruped Cheetah platform. The robots will engage in an interaction with a human caretaker at the level of a young child playing an open-ended game in a cluttered and rough environment. Hardware and software solutions will be made publicly available as open source. Ultimately, the naturalness of such compliant robots will allow them to blend into everyday life.

Co-ordinator: Prof. Jochen J. Steil, UNIVERSITAET BIELEFELD, DE

Participants:

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE	CH
TECHNISCHE UNIVERSITAET GRAZ	AT
FONDAZIONE SANTA LUCIA	IT
UNIVERSITEIT GENT	BE
EBERHARD KARLS UNIVERSITAET TUEBINGEN	DE
UNIVERSITAET ZUERICH	CH
FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA	IT
JACOBS UNIVERSITY BREMEN GGMBH	DE
WEIZMANN INSTITUTE OF SCIENCE	IL

COGNITO

ICT Call: FP7-ICT-2009-4
ID: 248290 - COGNITO
Title: Cognitive Workflow Capturing and Rendering with On-Body Sensor Networks
Duration: 36 months
Funding: 3, 240 Keuros

Summary

The automatic capture, recognition and rendering of human sensory-motor activities represent essential technologies in many diverse applications, ranging from 3D virtual manuals through to training simulators and novel computer games. Although capture systems already exist on the market, they focus primarily on capturing raw motion data, matched to a coarse model of the human body. Moreover, the recorded data is organised as a single cinematic sequence, with little or no reference to the underlying task activity or workflow patterns exhibited by the human subject. The result is data which is difficult to use in all but the most straightforward of applications and which requires extensive editing and user manipulation, especially when cognitive understanding of human action is a key concern, such as in virtual manuals or training simulators.

The aim of COGNITO is to address these issues by advancing both the scope and the capability of human activity capture, recognition and rendering. Specifically, it proposes to develop novel techniques that will allow cognitive workflow patterns to be analysed, learnt, recorded and subsequently rendered in a user-adaptive manner. The concern will be to map and closely couple both the afferent and efferent channels of the human subject, enabling activity data to be linked directly to workflow patterns and task completion. The work will focus particularly on tasks involving the *hand manipulation of objects and tools* due to their importance in many industrial applications. The key objectives of the project are to develop a novel on-body sensor network consisting of miniature inertial and vision sensors, estimate an osteo-articular model of the human body, recover the workflow digitally, and develop novel rendering mechanism for effective and user-adaptive visualization. The work will be done within the context of designing effective user assistance systems based around augmented reality techniques for specialised industrial manufacture and will be carried out in close collaboration with industrial and end user partners..

Co-ordinator: Prof. Didier Stricker, DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH, DE

Participants:

UNIVERSITY OF BRISTOL	UK
UNIVERSITY OF LEEDS	UK
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS) / University of Compiegne	FR
Trivisio Prototyping GmbH	DE
Associação CCG/ZGDV - Centro de Computação Gráfica	PT
Technologie Initiative SmartFactory KL e.V.	DE

EUROBOTICS

ICT Call: FP7-ICT-2009-4.
ID: 248552 - euRobotics
Title: Coordination Action for Robotics in Europe
Duration: 36 months
Funding:1,999 Keuros

Summary

euRobotics aims to improve cooperation between industry and academia and enhance public perception of (European) robotics. It will build on successful coordination activities which have been undertaken over the past few years within the academic and industrial robotics communities, in particular through EURON and EUROP, by following a policy of targeted stimulation of grass-roots initiatives that both communities have already experimented with.

To help the two communities to communicate more efficiently, the project will develop a common terminology and a common perception of the state of the art. euRobotics will also create a high-level education and training initiative for both PhD students in robotics and R&D engineers in robotics companies. It will encourage academia to demonstrate their abilities in industrially relevant challenges and competitions. Last, but not least, the CA will help to ensure that technological developments will reach the market not only through existing channels, but also through newly established companies.

euRobotics will provide coordinated communication channels aiming at both the general public and professional audiences, including national funding bodies, and representatives from neighbouring technology and market domains, such as cognitive science, mechatronics, automotive, aerospace, security, computer vision, and embedded control systems. The CA will also address ethical, legal and societal topics as well as market and standards–related issues

Co-ordinator: Rainer Bischoff, KUKA Roboter GmbH, DE

Participants:

EUnited aisbl	BE
KATHOLIEKE UNIVERSITEIT LEUVEN	BE
UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II.	IT
R.U.Robots Limited	UK
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	DE
GPS GESELLSCHAFT FUR PRODUKTIONSSYSTEME GMBH	DE
FATRONIK Tecnalia.	ES
COMMISSARIAT ENERGIE ATOMIQUE CEA	FR
ALENIA AERONAUTICA SPA	IT
TECHNISCHE UNIVERSITAET MUENCHEN	DE

FIRST-MM

ICT Call: FP7-ICT-2009-4
ID: 248258 - FIRST-MM
Title: Flexible Skill Acquisition and Intuitive Robot Tasking for Mobile Manipulation in the Real World
Duration: 42 months
Funding: 2,997 Keuros

Summary

The development of flexible mobile manipulation systems is a promising area for the robotics industry as it allows to combine the success of manipulation robots with the flexibility of mobile robots. Many industrial processes depend highly on the reliability and robustness of robotic manipulators. On the other hand, research on mobile robots has led to systems which demonstrate a capability for safe and accurate navigation. The goal of this project is to integrate these two areas in the context of a real-world application scenario, in order to build the basis for a new generation of autonomous mobile manipulation robots that can flexibly be instructed to perform complex manipulation and transportation tasks. The project will develop a novel robot programming environment that allows even non-expert users to specify complex manipulation tasks in real-world environments. In addition to a task specification language, the environment includes concepts for probabilistic inference and for learning manipulation skills from demonstration and from experience. The project will build upon and extend recent results in robot programming, navigation, manipulation, perception, learning by instruction, and statistical relational learning to develop advanced technology for mobile manipulation robots.

The project results will be evaluated in a real-world setting involving mobile manipulation platforms built from state-of-the-art components and controlled by a fully integrated software system containing all developed components. The integrated system will, starting from a task specification, be capable of acquiring necessary low-level manipulation skills, imitating mobile manipulation behaviours demonstrated by a human with which it interacts and, most importantly, will be able to generalize about such demonstrated behaviours to autonomously solve other tasks.

Co-ordinator: Prof. Wolfram Burgard, ALBERT-LUDWIGS-UNIVERSITAET FREIBURG, DE

Participants:

FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS	EL
KATHOLIEKE UNIVERSITEIT LEUVEN	BE
INSTITUTO SUPERIOR TECNICO, LISBON	PT
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	DE
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE	CH
TECHNISCHE UNIVERSITAET BERLIN	DE
KUKA Roboter GmbH	DE

GARNICS

ICT Call: FP7-ICT-2009-4
ID: 247947 - GARNICS
Title: Gardening with a Cognitive System
Duration: 36 months
Funding: 2,871Keuros

Summary

The GARNICS project aims at 3D sensing of plant growth and building perceptual representations for learning the links to actions of a robot gardener. Plants are complex, self-changing systems with increasing complexity over time. Actions performed towards plants (like watering), will have strongly delayed effects. Thus, monitoring and controlling plants is a difficult problem in terms of perception-action, requiring advanced predictive cognitive properties, which so far can only be provided by experienced human gardeners.

Sensing and control of a plant's actual properties, i.e. its phenotype, is relevant to e.g. seed production and plant breeders. GARNICS addresses plant sensing and control by combining active vision with appropriate perceptual representations, which are essential for cognitive interactions. Core ingredients for these representations are channel representations, dynamic graphs and cause-effect couples (CECs). Channel representations are wavelet-like, biologically motivated information representations, which can be generalized coherently using group theory. Using these representations, plant models - represented by dynamic graphs - will be acquired and by interacting with a human gardener the system will be taught the different cause-effect relations resulting from possible treatments. Employing decision making and planning processes via CECs, the robot gardener will then be able to choose the appropriate actions for optimal plant growth from its learned repertoire.

This way the project will arrive at an adaptive, interactive cognitive system, which will be implemented and tested in an industrially-relevant plant-phenotyping application.

Co-ordinator: Dr. Thomas Gollan, FORSCHUNGSZENTRUM JUELICH GMBH, DE

Participants:

LINKOPINGS UNIVERSITET	SE
GEORG-AUGUST-UNIVERSITAET GOETTINGEN STIFTUNG OEFFENTLICHEN RECHTS	DE
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	ES

GERT

ICT Call: FP7-ICT-2009-4
ID: 248273 - GeRT
Title: Generalizing Robot Manipulation Tasks
Duration: 36 months
Funding: 2,824 Keuros

Summary

In order to work naturally in human environments such as offices and homes, robots of the future will need to be much more flexible and robust in the face of novelty than those of today. In GeRT we will develop new methods to cope with novelty in manipulation tasks.

Humans cope so seamlessly with novel objects that we do not think of grasping a new cup, or screwing the lid off a jar we haven't seen before as challenging. But this kind of everyday novelty in manipulation tasks is hard for a robot. Currently the most advanced robots can perform a task such as making a drink, which involves grasping, pouring, and twisting off a cap from a jar. But the rules for how to pick up every single object must be programmed. All of this means that if robots are ever going to be useful in natural settings where manipulation is involved that they need ways of generalising on the fly to cope with novel objects, and perhaps novel tasks.

Our approach is to take a small set of existing robot programs, for a certain robot manipulation task, such as serving a drink and to give the robot the ability to adapt them to a novel version of the task. These programs constitute a database of prototypes representing that class of task. When confronted with a novel instance of the same task the robot needs to establish appropriate correspondences between objects and actions in the prototypes and their counterparts in the novel scenario. In this way the robot can solve a task that is physically substantially different but similar at an abstract level. To achieve this we will use a variety of techniques from machine perception, machine learning, and artificial intelligence techniques such as automated planning.

Co-ordinator: Dr. Cristoph Borst, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, DE

Participants:

THE UNIVERSITY OF BIRMINGHAM	UK
OREBRO UNIVERSITY	SE
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	DE

HUMAVIPS

ICT Call: FP7-ICT-2009-4
ID: 247525 - HUMAVIPS
Title: Humanoids with auditory and visual abilities in populated spaces
Duration: 36 months
Funding: 2, 636 Keuros

Summary

Humanoids which are expected to collaborate with people should be able to interact with them in the most natural way possible. This involves significant perceptual, communication, and motor processes, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to explore a populated space, localize people and determine their status, decide to join one or two persons, synthesize appropriate behaviour, and engage in dialogue with them. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi sensory data processing, from low-level 3D object positioning to high-level gesture recognition and dialogue handling.

Understanding the world on the basis of unrestricted sensorial data, recognizing people's intentions and behaving like them are extremely challenging problems. The objective of HUMAVIPS is to endow humanoid robots with audiovisual abilities like exploration, recognition and interaction, so that they exhibit adequate behaviour when dealing with a group of people. Planned research and technological development during the project will emphasize the role played by multimodal perception within principled models of human-robot interaction and of humanoid behaviour. An adequate architecture will implement auditory and visual skills on a fully programmable humanoid robot. An open-source software platform will be developed to foster dissemination and to ensure exploitation of the results beyond the lifetime of the project.

Co-ordinator: Dr. Radu Horaud, INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE, FR

Participants:

CESKE VYSOKE UCENI TECHNICKE V PRAZE (CZECH TECHNICAL UNIVERSITY)	CZ
ALDEBARAN Robotics	FR
IDIAP (FONDATION DE L'INSTITUT DALLE MOLLE D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE)	CH
UNIVERSITAET BIELEFELD	DE

IURO

ICT Call: FP7-ICT-2009-4
ID: 248314 - IURO
Title: Interactive Urban Robot
Duration: 36 months
Funding: 3,487 Keuros

Summary

The inability to cope with abstract commands confines today's robots to very constrained, well-controlled environments. To overcome these limitations, *a-priori* knowledge – preprogrammed or learned – is required. However, as objectives and situations may radically change over time there will always be knowledge gaps. Even if provided with sophisticated cognitive capabilities, sufficient information will not always be available in the environment to fill these gaps. Humans, however, are a rich source of information to be utilized, e.g. by asking for directions. Access to this source provides robots with a powerful means to improve its adaptability and cope with new situations as they arise.

The IURO project explores the integration of information retrieval from humans into robot control architectures to complement their perception and action control capabilities. IURO follows a multi-disciplinary approach combining environment perception, communication, navigation, knowledge representation and assessment, and human factors studies as well as a novel robot platform for human-centred urban environments as a pre-industrial development.

IURO focuses on several key aspects: perception and appropriate representation of dynamic urban environments; identification of knowledge gaps arising from dynamically changing situations and contexts not specified a priori; retrieval of missing information from humans in a natural way by pro-actively approaching them and initiating communication situations.

Quantitative and comparative benchmark measures considering flexibility and robustness with respect to navigation and interaction capabilities in real-world scenarios are developed. IURO targets novel technologies for new commercial service robots with improved flexibility and dependability.

Co-ordinator: Prof. Martin Buss, TECHNISCHE UNIVERSITAET MUENCHEN, DE

Participants:

Eidgenössische Technische Hochschule Zürich	CH
UNIVERSITAET SALZBURG	AT
KUNGLIGA TEKNISKA HOEGSKOLAN	SE
ACCREA Bartlomiej Stanczyk	PL

MASH

ICT Call: FP7-ICT-2009-4.
ID: 247022 - MASH
Title: Massive Sets of Heuristics for Machine Learning
Duration: 36 months
Funding: 2,309Keuros

Summary

MASH aims at creating new tools for the collaborative development of very complex machine learning systems. Machine learning is at the interface between computer science and mathematics and is concerned with the design of software able to learn from example. Thanks to such methods, instead of having experts finely tune all the parameters of a program, the computer automatically adapts its functioning so that it works well on available training data. Machine learning relies on the ad-hoc design of feature extractors, pieces of software designed by experts and able to compute meaningful quantities from the signal to process. These quantities are fed to the learning system, which makes a decision based on them. Combining several types of features developed by independent teams usually improves performance. As they exploit different sources of information, different modules mutually compensate their weaknesses.

The goal of the MASH project is to investigate such a strategy in a principled way, by developing new theoretical tools and software to help large groups of individuals design large families of feature extractors. This will result in a dramatic increase of the overall system complexity. The project will be organized around an open web-based platform where contributors will find the tools to interact and communicate with each other, and the means to integrate their feature extractors in continuously running experiments. From the outcome of these experiments, the system will provide quantitative feedback about the performance of the submitted modules. The approach will be demonstrated through two robotic applications: the control of an avatar in a 3D video-game environment and the control of a real robotic arm.

The main outcome of this project will be novel tools and organizational principles for research groups and industries wishing to implement large team development for machine learning. It will also produce an open-source pool of feature extractors and encourage public participation.

Co-ordinator: Dr. François Fleuret, IDIAP (FONDATION DE L'INSTITUT DALLE MOLLE D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE), CH

Participants:

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	FR
Forschungsverbund Berlin E.V. (WIAS)	DE
INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE	FR
CESKE VYSOKE UCENI TECHNICKE V PRAZE (CZECH TECHNICAL UNIVERSITY)	CZ

NIFTI

ICT Call: FP7-ICT-2009-4
ID: 247870 - NIFTi
Title: Natural human-robot cooperation in dynamic environments
Duration: 48 months
Funding: 6,611 Keuros

Summary

NIFTi focuses on the human factor in cognitive architectures and investigates how natural behaviour in human-robot cooperation can arise. It aims at operationalizing natural cooperation by balancing operational and cooperation demands in a cognitive architecture (CA), in order to minimize human cognitive task load and optimize joint work flow.

CAs will be designed in NIFTi by closely coupling cognitive user models to the way the architecture understands the environment, the way it performs actions, the way it communicates. The CA acquires maps combining perceptual- and conceptual information and combines this information with cognitive user models in order to predict why changes in human behaviour (due to attention, task load) may occur. Then it uses these predictions to anticipate how it should adapt acting and communication to align with the human. The CA bases planning and execution in a cognitive control model. Control uses attention, characteristics of agent morphology, and skill acquisition, to guide autonomous action in a cooperative context. The CA achieves balance by actively interconnecting content across modules. Content in modules is not isolated: controllers interconnect content across modules thereby percolating content changes throughout the CA thereby ensuring coherency in all the system. Controllers are learning off- and online, using reinforcement learning and statistical (relational) learning. The entire architecture is therefore tuned towards the adaptation to and cooperation with humans.

The application domain is Urban Search and Rescue and several end user organisations are involved in the project.

Co-ordinator: Dr. Geert-Jan Kruijff, DFKI (DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ) GMBH, DE

Participants:

NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO	NL
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	DE
BLUEBOTICS SA	CH
Eidgenössische Technische Hochschule Zürich	CH
CESKE VYSOKE UCENI TECHNICKE V PRAZE	CZ
UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA	IT
STADT DORTMUND Institut fuer Feuerwehr und Rettungstechnologie FDDo	DE
MINISTERIO DELL'INTERNO Corpo Nazionale Vigili del Fuoco	IT

RADHAR

ICT Call: FP7-ICT-2009-4.
ID: 248873 - RADHAR
Title: Robotic ADaptation to Humans Adapting to Robots
Duration: 36 months
Funding: 2,418 Keuros

Summary

RADHAR will develop a driving assistance system involving environment perception, driver perception and modelling, and robot decision making. RADHAR proposes a framework to seamlessly fuse the inherently uncertain information from both environment perception and the driver's steering signals by estimating the trajectory the robot should execute, and to adopt this fused information for safe navigation with a level of autonomy adjusted to the user's capabilities and desires. This requires lifelong, unsupervised but safe learning by the robot. As a consequence, a continuous interaction between two learning systems (the robot and the user) will emerge, hence Robotic ADaptation to Humans Adapting to Robots (RADHAR).

The framework will be demonstrated on a robotic wheelchair platform that navigates in an everyday environment with everyday objects.

RADHAR targets as main scientific outcomes: online 3D perception combining laser scanners and vision with traversability analysis of the terrain; novel paradigm for fusing environment and user perception and for safe robot navigation.

Co-ordinator:
Prof. Joris De Schutter, KATHOLIEKE UNIVERSITEIT LEUVEN, BE

Participants:

ALBERT-LUDWIGS-UNIVERSITAET FREIBURG	DE
PROFACTOR GMBH	AT
HMC International	BE
Eidgenössische Technische Hochschule Zürich	CH
Permobil AB	SE
Windekind VZW Centrum voor buitengewone zorg	BE
Nationaal Multiple Sclerose Centrum vzw	BE

ROBOEARTH

ICT Call: FP7-ICT-2009-4.
ID: 248942 - RoboEarth
Title: RoboEarth: robots sharing a knowledge base for world modelling and learning of actions
Duration: 48 months
Funding: 3,958Keuros

Summary

The RoboEarth-project exploits a new approach towards endowing robots with advanced perception and action capabilities, thus enabling robots to carrying out useful tasks autonomously in circumstances that were not planned for explicitly at design time. The core of the innovation involves the development of a world-wide web-style database. RoboEarth will allow robots to share any reusable knowledge independently of their hardware and configuration. When a robot starts performing a task, it is able to download available high-level knowledge on both the task and the environment. Next, it can use and translate this knowledge to its hardware specifications and its configuration and will improve it by learning during the task. Finally, it will upload its knowledge to the RoboEarth database again.

As a result of the project, major innovations are expected in the fields of 3D sensing (object recognition and localization), control strategies (linking perception and action), and learning. Besides these new methods which fully exploit available *a-priori* knowledge, RoboEarth will, due to its standardized way of sharing knowledge, contribute to a more modular design of robotic systems. Robot hardware with a hardware abstraction layer (HAL) for RoboEarth will be enough to build a functional robot, using the knowledge available from the database.

A series of demonstrators in hospital surroundings will show the contributions of the project for example: the *Action Recipe* demonstrator will show robots creating/uploading and downloading/executing action recipes; the *Ask Meal* demonstrator will present meal options to a patient in a hospital room; the *Serve Drink* demonstrator will integrate 3D-sensing in the task by presenting a drink to the patient. The *Screw Cap* demonstrator will add improvement of the task by learning to remove the screw cap from a bottle and *A Week In The Hospital* demonstrator will show that history data from RoboEarth will enable a robot to improve its performance. Through its approach, RoboEarth proposes to pave the way for completely new markets.

Co-ordinator: Dr. René van de Molengraft, TECHNISCHE UNIVERSITEIT EINDHOVEN, NL

Participants:

PHILIPS ELECTRONICS NEDERLAND B.V.	NL
UNIVERSITAET STUTTGART	DE
Eidgenössische Technische Hochschule Zürich	CH
UNIVERSIDAD DE ZARAGOZA	ES
TECHNISCHE UNIVERSITAET MUENCHEN	DE

ROBOSOM

ICT Call: FP7-ICT-2009-4.
ID: 248366 - RoboSoM
Title: A Robotic Sense of Movement
Duration: 36 months
Funding: 1,659 K euros

Summary

The objective of the project is to investigate and to apply new approaches to the design and development of humanoid robots with advanced perception and action capabilities, showing robust, adaptive, predictive and effective behaviour in the real world. The proposed new approaches are based on the concept of the human sense of movement. There are two main ideas related to this concept, which are relevant to robotics: the vestibular unified reference frame, as set by the vestibular system in the centre of the head; and Expected Perception (EP), or the capability to make predictions of consequences of actions, which is at the basis of the human predictive behaviour. The expected robot behaviour is the capability to follow a visual target by coordinating eye, head, and leg movements, with head stabilization, walking smoothly and effectively in an unstructured environment, with a robust reactive behaviour, improved by predictions. This behaviour is a fundamental, but quite novel, capability for humanoid robots, and it may result in a truly robust and effective behaviour in many helpful tasks in real-world scenarios.

The project will use the existing and fully operational Sabian biped humanoid robotic platform, which is a copy of the Waseda University Wabian robot. The legs have a functional hip and waist DoF that allow the leg and head movements to be de-coupled. This unique feature guarantees a truly human-like walking behaviour with head stabilization. IST has developed and has in its laboratory the same head as the Sabian robot.

It is the strong belief of the consortium that the service robotics markets needs a new generation of robotic system with better behaviour in the real world, in terms of sensory-motor performance, adaptability, robustness, and that understanding the principles underlying the biological brain sense of movement can lead to the design of robots that represent one important step in this direction.

Co-ordinator: Prof. Paolo Dario, SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA, IT

Participants:

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	FR
INSTITUTO SUPERIOR TECNICO	PT
WASEDA UNIVERSITY	JP

TACO

ICT Call: FP7-ICT-2009-4.
ID: 248623 - TACO
Title: Three-dimensional Adaptive Camera with Object Detection and Foveation
Duration: 36 months
Funding: 3, 572 Keuros

Summary

TACO develops a three dimensional sensing system with 3D foveation properties endowing service robots with a higher level of motion and affordance perception and interaction capabilities with respect to everyday objects and environments.

The 3D foveation properties are based on the process of acquiring 3D images at a coarse level of detail, applying fast object recognition techniques to identify areas of interest in the coarse 3D image and then concentrate the image acquisition on details of interest, thus allowing for higher resolution 3D sampling of these details. This new 3D foveation concept will allow robots to interact with everyday environments in a more natural and human-like manner, increasing the level of detail whenever needed for interaction between the robot and everyday objects and humans.

These 3D foveation properties are achieved by utilising the power of micro-mirror MEMS technology combined with state-of-the-art time-of-flight methods to develop a system that is small, light-weight and easily mounted on an ordinary-sized service robot or even on a robot arm. TACO will explore control strategies for 3D foveation allowing 3D robot vision that is adaptable with space- and time-variant sampling, processing and understanding. The project will verify and test the 3D sensing system in a robotic environment, exploring the capabilities of the system to allow the robot to navigate autonomously and interact with a diverse number of everyday objects.

Co-ordinator: Dr. Klaus-Michael Koch, TECHNIKON FORSCHUNGS- UND PLANUNGSGESELLSCHAFT MBH, AT

Participants:

THE SHADOW ROBOT COMPANY LIMITED	UK
OXFORD TECHNOLOGIES LTD	UK
TECHNISCHE UNIVERSITAET WIEN	AT
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	DE
STIFTELSEN SINTEF	NO
CTR CARINTHIAN TECH RESEARCH AG	AT

THE

ICT Call: FP7-ICT-2009-4.
ID: 248587 - THE
Title: The Hand Embodied
Duration: 48 months
Funding: 7,176 Keuros

Summary

The scientific goals of the project concern the reciprocal linkages between the physical hand and its high-level control functions, and the way that the embodiment enables and determines its behaviours and cognitive functions. *The Hand Embodied* refers to the "hand" as both a cognitive entity – standing for the sense of active touch – and as the physical embodiment of such sense, the organ, comprised of actuators and sensors that ultimately realize the link between perception and action. The study of the intrinsic relationship between the hand as a cognitive abstraction and its bodily instance will be made possible by (a) performing neuroscientific and perceptual behavioural studies with participants engaged in controlled manual activities and (b) the parallel development of a theoretical framework to lay the foundations for design and control of robotic hands and haptic interfaces.

The general idea is to study how the embodied characteristics of the human hand and its sensors, the sensorimotor transformations, and the very constraints they impose, affect and determine the learning and control strategies we use for such fundamental cognitive functions as exploring, grasping and manipulating. By learning from human data and hypotheses-driven simulations how to devise improved system architectures for the hand as a cognitive organ, the ultimate goal of the project is to design and control new and improved robot hands, haptic interfaces and hand prostheses. The project hinges on the conceptual structure and the geometry of such enabling constraints or *synergies*: correlations in redundant hand mobility (motor synergies), correlations in redundant cutaneous and kinaesthetic receptors readings (multi-cue integration), and overall sensorimotor system synergies. These also form the project's key ideas behind advancing the state of the art in artificial systems for robotic manipulation and haptic and neuroprosthetic interfaces.

Co-ordinator: Prof. Antonio Bicchi, UNIVERSITA DI PISA, IT

Participants:

DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV	DE
NATIONAL TECHNICAL UNIVERSITY OF ATHENS	EL
Università degli Studi di Siena	IT
UNIVERSITEIT UTRECHT	NL
UNIVERSITE PIERRE ET MARIE CURIE - PARIS 6	FR
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	DE
LUNDS UNIVERSITET	SE
Swedish Institute of Computer Science	SE
Arizona State University [Associated]	USA

TRIDENT

ICT Call: FP7-ICT-2009-4.
ID: 248497 - TRIDENT
Title: Marine Robots and Dexterous Manipulation for Enabling Autonomous Underwater Multipurpose Intervention Missions
Duration: 36 months
Funding: 3,248 Keuros

Summary

TRIDENT proposes a new methodology for multipurpose underwater intervention tasks with diverse potential applications like underwater archaeology, oceanography and offshore industries, and goes beyond present-day methods typically based on manned and / or purpose-built systems. Trident is based on new forms of cooperation between an Autonomous Surface Craft and an Intervention Autonomous Underwater Vehicle.

Firstly, the I-AUV performs a path following survey, where it gathers optical and / or acoustic data from the seafloor, whilst the ASC provides geo-referenced navigation data and communications with the end user. The motion of the ASC will be coordinated with that of the I-AUV for precise Ultra Short Base Line positioning and reliable acoustic communications. After the survey, the I-AUV docks with the ASC and sends the data back to a ground station where a map is set up and a target object is identified by the end user. Secondly, the ASC navigates towards a waypoint near the intervention area to search for the object. When the target object has been found, the I-AUV switches to free floating navigation mode. The manipulation of the object takes place through a dextrous hand attached to a redundant robot arm and assisted with proper perception. Particular emphasis will be put on the research of the vehicle's intelligent control architecture to provide the embedded knowledge representation framework and the high level reasoning agents required to enable a high degree of autonomy and on-board decision making of the platform.

The new methodology will allow the user to specify an intervention task to be undertaken with regards to a particular target object, but after that the object is automatically recognised and manipulated by the robot in a completely autonomous way.

Co-ordinator: Prof. Pedro J Sanz, UNIVERSITAT JAUME I DE CASTELLON, ES

Participants:

UNIVERSITAT DE GIRONA	ES
UNIVERSITAT DE LES ILLES BALEARS	ES
ALMA MATER STUDIORUM-UNIVERSITA DI BOLOGNA	IT
UNIVERSITA DEGLI STUDI DI GENOVA	IT
INSTITUTO SUPERIOR TECNICO	PT
HERIOT-WATT UNIVERSITY	UK
GRAAL TECH SRL	IT

VANAHEIM

ICT Call: FP7-ICT-2009-4.
ID: 248907 - VANAHEIM
Title: Video/Audio Networked surveillance system enhAncement through Human-cEntered adaptIve Monitoring
Duration: 42 months
Funding: 3, 718 Keuros

Summary

The aim of VANAHEIM is to study innovative surveillance components for autonomous monitoring of complex audio/video surveillance infrastructure, such as in shopping malls or underground stations. It will address:

1. Scene activity modelling algorithms for automatic sensor selection in the control room, monitoring both empty and occupied scenes. Models to characterise the content of video and audio streams, in terms of usual and unusual activities are particularly needed in the latter case.

2. Investigation of subtle human behavioural cues (head pose, body shape) and social models (e.g. about space occupancy) to perform live detection of well-defined scenarios of interest. The project targets three specific levels of monitoring: individuals, groups of people and crowd / people flow as well as situational awareness reporting.

3. Collective behaviour building and online learning from long-term analysis of passenger activity, by combining cognitive science and ethological analysis. VANAHEIM aims to build up long-term trends of large-scale human behaviour, thus allowing the discovery of collective comprehensive daily routines.

VANAHEIM deployment in underground transport sites in Paris and Turin will help demonstrate the scalability and performance of the developed system.

Co-ordinator: Mr. Cyril Carincotte, MULTITEL ASBL, BE
Participants:

Gruppo Torinese Trasporti	IT
IDIAP (FONDATION DE L'INSTITUT DALLE MOLLE D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE)	CH
INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE	FR
University of Vienna, Ludwig Boltzmann Institute for Urban Ethology	AT
REGIE AUTONOME DES TRANSPORTS PARISIENS	FR
THALES COMMUNICATIONS SA	FR
Thales Italia spa	IT