Special Issue on Advances on Physical Agents 2012

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***Abstract*—The Workshop on Physical Agents intends to be a forum for information and experience exchange in different areas regarding the concept of embodied agents, especially applied to the control and coordination of autonomous systems: robots, mobile robots, domotics, agents, industrial applications or complex systems. This special issue brings together a selection of revised and extended papers that were first presented at the *XIII Workshop on Physical Agents* (WAF'2012), which was held the 3rd and 4th of September 2012 at the University of Santiago de Compostela (Spain).**

***Index Terms*—WAF, Physical Agents**

I. Editorial

Dear readers, this issue of the Journal of Physical Agents (JoPhA) brings together a selection of revised and extended papers that were first presented at the *XIII Workshop on Physical Agents* (WAF'2012). This edition of the workshop was held the 3rd and 4th of September 2012 at the University of Santiago de Compostela (Spain), coinciding with the opening of an important research centre, CITIUS (*Centro Singular de Investigación en Tecnoloxías da Información*). This new research centre has sponsored and supported the celebration of WAF'2012.

The Workshop on Physical Agents (WAF) is an annual forum of discussion and exchange of ideas whose first edition took place in 2000. Nevertheless, with the passing of time, this workshop has consolidated as an important Spanish platform to present and discuss trends and developments in disciplines that contribute towards the design and deployment of physical agents in physical environments. Contributions to WAF are usually received from robotics research groups in Spain, but also increasingly from other countries (this year there were contributions from researchers working in Northern Ireland, Japan and Algeria). Therefore, WAF continuous to gain relevance as a workshop that brings together students and senior scientists to discuss pressing questions and identify future research directions in all areas related with robotics and its application to industry.

During the thirteenth edition of WAF celebrated this year in Santiago de Compostela, the attendants to the workshop could enjoy not only the usual oral presentations and discussion of the accepted papers, but also some interesting live demonstrations and exhibitions which put on stage some of the experiments described in the papers. In particular we could see: 1) a robot learning in real time from simple user feedback; 2) a NAO robot that is being used to help patients suffering from Alzheimer; 3) the use of a haptic interface to include the sense of touch in games aimed for people that need rehabilitation or training in reasoning and spatial skills; 4) the use of a very original mobile platform and augmented reality to help elderly people; 5) a very nice robotic head called MUECAS, able to recognize and imitate facial expressions detected in a human interlocutor; 6) mini-robots being used to solve internal transportation logistic in a simulated laboratory for clinical analyses; 7) a guide robot equipped with a gesture based interface, and able to provide voice feedback to allow humans to cooperate and interact with the robot in a very easy and natural way.

For the first time, this year the programme of WAF comprised an Industry-Academia session, entitled *Robots in the shop windows: present and future*. This session put researchers in touch with enterprising people responsible for new robotic companies, allowing the exchange of different points of views, the learning from the experiences of these enterprising people, or even the acquisition of information about the challenges that these emerging companies have yet to face.

The topics presented at the workshop covered an important part of the spectrum of robotics: robot localization, development and learning of robot controllers, human-robot interaction in service robots, sensors and actuators, multi-robot systems and path planning. On the other hand the papers presented spread from theoretical investigations to practical applications. In this sense, we are inclined to think that the practical applications presented at the conference are somehow biased towards the achievement of assistive robots or robots able to adapt and collaborate with people.

This aspect has been reinforced by the two very inspiring plenary sessions given by Yiannis Demiris (Reader in intelligent and assistive robotics and head of the Personal Robotics Laboratory at the Department of Electrical and Electronic Engineering at Imperial College London, UK) and Jan Peters (full professor at the Technische Universitaet Darmstadt, Germany, and senior research scientist at the Max Planck Institute for Intelligent Systems). Y. Demiris spoke about his research on bidirectional assistance between humans and robots, robots which can not only learn from human observation and imitation, but they can also build adaptive user models and modify their level of assistance to adapt to changing user needs.

J. Peters spoke about the importance of robots that can learn tasks triggered by environmental context or higher level instructions as an important step towards the achievement of robots able to assist humans in situations of daily life. He presented a general framework suitable for learning motor skills in robotics which involves generating a representation of motor skills by parameterized motor primitive policies acting as building blocks of movement generation. Thus, he presented robot-learning in three different levels of abstraction:

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learning for accurate robot control, learning of motor skills, and learning of the task-dependent hyperparameters of these motors primitives to solve complex tasks.

This special issue of selected papers reflects the eclectic range of topics presented at WAF'2012. In particular this journal contains revisions and extended versions of the seven papers which got the highest ratings according to the votes issued by the attendants to the workshop.

One of the first topics tackled in this issue is indoor mapping and localization. Regarding this topic, J. López et al., study the implementation of new sensors and techniques for indoor localization. They evaluate and compare a commercial system (Hagisonic StarGazer) and their low cost localization system based on the popular Wii remote control (WiiMote). Both employ very low cost infrared (IR) reflective tags as landmarks. In a second contribution, C. Gamallo et al., apply Simultaneous Localization and Mapping (SLAM) with omni-directional cameras, in this case the lights placed on the ceiling are the landmarks. In this work they had to face challenges such as data association or the initialization of the landmarks with a bearing-only sensor.

A second topic tackled in this issue is the development of human-robot interfaces; the increasing demand of service robots makes necessary the existence of natural human-machine interaction. Just as happens with humans (able to use gestures in their communication), it is necessary to endow robots with these gestural communication capabilities. In this sense, this issue includes a paper (F. Cid et al.) that describes a new proposal for recognition and imitation of a set of facial expressions using the visual information acquired by the robot. The system detects and imitates the interlocutor head's pose and motion. It also introduces the concept of models of the human and robot facial expressions, which are included inside of a new cognitive module aimed to enhance the human-robot interaction. In another paper (D. Loza et al.) describe the design and construction of a realistic mechatronic head with high gesture capacity. The proposed design is based on the description of the facial expressions using the parameterization and codification of the face movements suggested by the Facial Action Coding System (FACS). The paper shows the implementation details of the mechatronic head and the way a set of servomotors can generate the basic actions units described by the FACS as well as the basic and more complex emotional gestures.

The fifth paper (M. A. Gutiérrez et al.) revises a very complete and successful control software architecture for robots: RoboComp. The authors present recent advances in the formal definition of the RoboComp component model and a new set of tools based on Domain Specific Languages that have been created to simplify the whole development cycle of the components. Moreover, a new robot simulation tool has been created providing perfect integration with RoboComp and better control over experiments than current existing simulators.

The sixth paper (F. Martín et al.) shows a new application of mobile robotics in a medical domain, specifically a cognitive stimulation tool in the treatment of Alzheimer. This article describes the application of the NAO robot as a tool that the doctors can use in therapy of Alzheimer patients. The robot helps the doctors to get and focus the attention of the patient, and hold it for longer than in the standard therapy sessions. The development of this RoboTherapy application includes the control software onboard the robot and some tools like the visual script generator or several monitoring tools, so that the doctors can easily supervise the robot behavior along the sessions. This software allows the doctors the management of a wide-ranging set of robot behaviors and other utilities (such as speech synthesis, play of music, ...) that can be used to improve the interaction with the patients and to increase their attention.

Finally, the last paper (P. Quintía et al.) describes a novel algorithm that allows fast and continuous learning on a physical robot working in real environments. The learning process is fully conducted by the interactions of a real robot working in real environments and the opinion (reward or punishment) provided by a human who observes what the robot does. The robot controller is molded from scratch using these interactions and no prior knowledge is provided to the robot in any other way. Despite the highly-non-deterministic reinforcement provided by the human, who usually changes his mind during the learning process, the algorithm is able to achieve fast robot adaptation to the diversity of different situations that the robot encounters while it is moving in several environments.

Finally, we think that this is a great opportunity to show our gratitude to all the attendants to the XIII Workshop of Physical Agents, and to all who somehow helped to make the celebration of this workshop possible. Of course we particularly wish to extend these thanks to everyone who contributed to this special issue (authors, reviewers). Finally, we also want to thank Miguel A. Cazorla Quevedo and Vicente Matellán Oliveira (Editors-in-Chief of the Journal of Physical Agents) for their work helping to prepare and supporting this special issue.

We look forward to seeing you at WAF'2013.