



International Journal of Systems Science

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/tsys20>

Intelligent multisensory systems in support of information society

Elena Navarro^a, Antonio Fernández-Caballero^b & Rafael Martínez-Tomás^c

^a Laboratory of User Interfaces and Software Engineering University of Castilla-La Mancha, Albacete, Spain Email:

^b natural and artificial Interaction Systems (n&aIS) University of Castilla-La Mancha, Albacete, Spain Email:

^c Artificial Intelligence Department, Universidad Nacional de Educación a Distancia, Madrid, Spain Email:

Published online: 17 Dec 2014.

To cite this article: Elena Navarro, Antonio Fernández-Caballero & Rafael Martínez-Tomás (2014) Intelligent multisensory systems in support of information society, International Journal of Systems Science, 45:4, 711-713, DOI: [10.1080/00207721.2014.844916](https://doi.org/10.1080/00207721.2014.844916)

To link to this article: <http://dx.doi.org/10.1080/00207721.2014.844916>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

GUEST EDITORIAL

Intelligent multisensory systems in support of information society

Nowadays, our environment is evolving more than ever in terms of connectivity and access to information, among others. People connected through social networks, such as Twitter or Facebook, upload photos, publish news about social events, etc. Many sensors that provide us with information about temperature, pollution, traffic congestion and energy consumption, among others, are being installed everywhere. Even our closest environment has greatly changed so that it now provides more information by means of motion sensors, surveillance cameras, etc. This is one of the results of the so-called *information society* becoming a reality.

However, the availability of such a vast amount and diversity of information can be overwhelming for humans as it has to be processed, fused and analysed for building knowledge that is used to make decisions, recognise situations, etc. It is in this context where *intelligent multisensory systems* provide support to the information society. These systems are usually defined by two different features: (1) they *monitor* several types of sensors so that they are able to perceive the same environment from very different perspectives and (2) they *interpret* the activities that are taking place in the monitored environment by using some kind of artificial intelligence technique, such as the multi-agent systems paradigm.

These two features, monitoring and interpretation, have turned these systems into one of the most appropriate solutions for a wide variety of scenarios. For instance, they have proved their usefulness for the *monitoring and surveillance of physical environments* to recognise situations, activities and interactions among the different participating agents (e.g. humans, cars, aircraft, vessels or ships). This scenario is not restricted only to visual sensors, but also to other sensors capable of complementing and/or confirming the information extracted from video signals. Examples of this scenario can be as different as systems able to detect falls of elderly adults and to put into practice emergency plans, or systems able to support smart grids for the intelligent monitoring of distribution substations to detect events of interest, such as normal voltage values or unbalanced intensity values that can end up blowing fuses and decreasing the quality of service of end consumers. Another interesting scenario is the management of context-aware information in *ambient intelligent environments*. This involves the gathering, fusion, processing and inference of informa-

tion in sensor-oriented infrastructures to support ubiquitous applications. For instance, there are systems that provide caregivers with quick and accurate locations of their charges, access to critical treatment, etc.

Due to the inherent complexity of intelligent multisensory systems, their development becomes a challenging and demanding activity, mainly because three different research areas have to team up for providing appropriate solutions: *sensor networks*, *artificial intelligence* and *human-computer interaction*. The main objective of this special issue is to summarise recent advances in the area of intelligent multisensory systems. The published papers provide new ideas and problems, clearly indicating the advances made in problem statements, methodologies and applications with respect to the existing results. The special issue also includes papers focusing on advanced methods and presenting considerable novelties in theoretical background and experimental set-up. Some papers introduce applications to newly emerging fields, such as pervasive environments or sensor networks.

The advances in the sensor networks research area are critical for the development of intelligent multisensory systems as they determine both their monitoring capabilities and one main cost of the deployment of the systems. For this aim, the development of new kinds of sensors, the development of platforms for their control, as well as the identification of the type of sensors to be used and how they should be distributed over the area to be monitored, are critical factors for these systems.

In this special issue, two papers describe relevant advances related to sensor networks. Castillo, Engin, and Feliu Batlle (2014) introduce a two-degree-of-freedom flexible antenna sensor platform designed to physically simulate the ability of a robotic arm, which rapidly re-orientates and targets itself towards specific surfaces from different approachable angles. Gascueña, Castillo, Navarro, and Fernández-Caballero (2014) introduce a methodology called INT3-software development process (INT3-SDP), which provides the analysts with the guidelines and models necessary for the description of the environment to be monitored and the sensors to be installed, as well as in the implementation of the software components that perform the INTERpretation of behaviours and situations for an INTelligent INTervention in complex and dynamic environments.

As aforementioned, another critical research area in the development of intelligent multisensory systems is artificial intelligence through the use of different approaches such as intelligent agents and ontologies, among others (Gascueña and Fernández-Caballero 2011). The multi-agent approach has become one of the most successful for the development of these systems because their inherent characteristics of autonomy, communication among autonomous elements and distribution make them especially appropriate for monitoring tasks (Gascueña, Navarro, and Fernández-Caballero 2012). Therefore, in this special issue novel proposals exploiting multi-agent systems in the development of intelligent multisensory systems are described. Luis Bustamante, Molina, and Patricio (2013) introduce an architecture in which novelty resides in its decentralisation thanks to the exploitation of both intelligent sensors capable of decision-making and multi-agents to manage the spatially distributed areas. The defined architecture solves two important problems inherent to surveillance systems: data fusion and coordinated sensor-task management. Two other interesting works which present architectures specially developed for two previously identified scenarios, that is, monitoring and surveillance of physical environments and ambient intelligent environments, are included. Vallejo, Albusac, Glez-Morcillo, Castro-Schez, and Jiménez (2014) present a multi-agent architecture for smart grids with two interesting features. First, the architecture is highly scalable according to the needs as it facilitates the integration of new agents on demand. Second, the knowledge bases of the agents are built by means of a formal model for normality analysis and have proved their success for monitoring different aspects or events of interest. Finally, Su and Chiang (2014) describe an ambient intelligent community care platform that uses a sensor network and mobile agent technologies to facilitate both the monitoring of senior citizens and the management of their critical treatment and wellness data.

Also, the use of ontologies has proved its usefulness in the development of intelligent multisensory systems because it offers common and distributed languages for describing components, their own characteristics and their interrelationships, at the different levels of representation. Ontologies support the semantics of these components and the associated technology makes use of this explicit knowledge to infer and derive new conclusions. Gómez Alvarado, Martínez-Tomás, Arias Tapia, and Rincón Zamorano (2014) present a proposal of structure and technologies required for high-level semantic stages of Horus and the associated methodological principles are established with the aim of recognising specific behaviours and situations. The methodology distinguishes three semantic levels of events: low level (compromised with sensors), medium level (compromised with context) and high level (target behaviours). The ontology for ubiquitous systems has been used to integrate ontologies from specific domains

and together with semantic technologies has facilitated the modelling and implementation of scenes and situations by reusing components.

Finally, another interesting approach for developing intelligent multisensory systems is human–computer interaction. Indeed, there is a strong emphasis in intelligent multisensory systems for user interaction taking place through natural interfaces where the depicted scenarios are equipped with multimodal devices. Castillo et al. (2014) present a technological approach to detect falls of elderly people. The authors face some challenges that this field of research poses, namely in terms of the quality of the information, the accuracy of the classification and the issues related to privacy. In that sense, a multimodal approach is followed. A chest-worn accelerometer is used to classify activities and a video camera is used to detect the location of the user inside the house or a global positioning system receiver to provide location outside the home.

To sum up, this special issue provides an overview of the research progress in the area of intelligent multisensory systems. We want to thank all authors for submitting high-quality articles as they are the key to the special issue's success. We are also very grateful to the reviewers for their thorough and on-time reviews of the articles. Last but not least, we are deeply thankful to Professor Peter Fleming, editor-in-chief of *International Journal of Systems Science*, for his help and advice, which has helped us to make this special issue a reality.

References

- Castillo, J.C., Carneiro, D., Serrano-Cuerda, J., Novais, P., Fernández-Caballero, A., and Neves, J. (2014), 'A Multimodal Approach for Activity Classification and Fall Detection', *International Journal of Systems Science*, 45, 810–824.
- Castillo, C.F., Engin, S.N., and Feliu Batlle, V. (2014), 'Design, Dynamic Modelling and Experimental Validation of a 2DOF Flexible Antenna Sensor', *International Journal of Systems Science*, 45, 714–727.
- Gascueña, J.M., Castillo, J.C., Navarro, E., and Fernández-Caballero, A. (2014), 'Engineering the Development of Systems for Multisensory Monitoring and Activity Interpretation', *International Journal of Systems Science*, 45, 728–740.
- Gascueña, J.M., and Fernández-Caballero, A. (2011), 'On the Use of Agent Technology in Intelligent, Multisensory and Distributed Surveillance', *The Knowledge Engineering Review*, 26, 191–208.
- Gascueña, J.M., Navarro, E., and Fernández-Caballero, A. (2012), 'Model-Driven Engineering Techniques for the Development of Multi-Agent Systems', *Engineering Applications of Artificial Intelligence*, 25, 159–173.
- Gómez Alvarado, H.F., Martínez-Tomás, R., Arias Tapia, S.A., and Rincón Zamorano, M. (2014), 'Using Semantic Technologies and the OSU Ontology for Modelling Context and Activities in Multi-Sensory Surveillance Systems', *International Journal of Systems Science*, 45, 798–809.

- Luis Bustamante, A., Molina Lopez, J.M., and Patricio, M.A. (2013), 'A Practical Approach for Active Camera Coordination Based on a Fusion-Driven Multi-Agent System', *International Journal of Systems Science*, DOI:10.1080/00207721.2013.795632
- Su, C.-J., and Chiang, C.-Y. (2014), 'Pervasive Community Care Platform: Ambient Intelligence Leveraging Sensor Networks and Mobile Agents', *International Journal of Systems Science*, 45, 778–797.
- Vallejo, D., Albusac, J., Glez-Morcillo, C., Castro-Schez, J.J., and Jiménez, L. (2014), 'A Multi-Agent Approach to Intelligent Monitoring in Smart Grids', *International Journal of Systems Science*, 45, 756–777.

Elena Navarro
Laboratory of User Interfaces and Software Engineering
University of Castilla-La Mancha, Albacete, Spain
Email: Elena.Navarro@uclm.es

Antonio Fernández-Caballero
natural and artificial Interaction Systems (n&aIS) University
of Castilla-La Mancha, Albacete, Spain
Email: Antonio.Fdez@uclm.es

Rafael Martínez-Tomás
Artificial Intelligence Department, Universidad Nacional de
Educación a Distancia, Madrid, Spain
Email: rmtomas@dia.uned.es