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Editorial

Sensing, Perceiving, and Understanding Actions

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With the emergence of paradigms such as the smart city, Internet of Things, or the smart grid among some of the most relevant, distributed sensor networks have gained importance as an enabling tool for information gathering. However, in order to leverage these paradigms, the distributed systems are required to be endowed with advanced reasoning capabilities, whereas the retrieval of contextual information or the application of a set of simple rules does not suffice since elaborated responses are expected from these systems. A key concern of these paradigms, as well as of any other approach inspired in the principles of the artificial intelligence, is to replicate the human ability to interpret world events and actions and to react to them in the most suitable way. To achieve this goal, systems need to be provided with the means to sense, perceive, understand, and act, while considering the intrinsic constraints of distributed and autonomous systems. Acting is commonly addressed from the agency model perspective, while sensing is addressed from a more technological viewpoint in seeking devices capable of replicating human senses. Finally perceiving and understanding are approached by applying knowledge management and reasoning techniques. These techniques, however, often demand heavy load in computational resources or energy consumption.

This special issue intends to encompass state-of-the-art works in the different fields involved in action recognition for distributed systems.

From the sensing perspective, human action recognition has evolved from highly intrusive body sensor networks [1] to nonintrusive ones, such as smartphone sensors [2] or distributed cameras [3]. Despite the benefits of these nonintrusive means, important drawbacks arise as a result of the complexity of the problem and the corresponding high computational requirements posed by the diverse human action recognition algorithms involved in the solution. In this sense, the paper titled "*Activity recognition on smartphones via sensor-fusion and KDA-based SVMs*" presents a solution to overcome these drawbacks by providing a system that is capable of recognizing a large list of actions, invariant to circumstantial factors where the phone is being held (pocket or hand), while reducing the power use of the device.

In this regard, energy consumption is a concern that cannot be overlooked when deploying distributed sensors all over a large area. While approaches such as big data or data fusion are dealing with the challenges involved in managing large set of data, compressive sensing targets the efficient usage of energy resources, such as how to downsample signals in order to reduce the energy consumption required to process, transmit, and store those data. The work titled "*An improved Toeplitz measurement matrix for compressive sensing*" presents an FPGA solution for efficient signal acquisition and reconstruction. The energy consumption problem is even more concerning, to the point of being the major issue, in case of sensor networks comprising wireless devices. In this sense, the work titled "*Wireless sensor networks energy effectively distributed target detection*" describes an approach for node detection that minimizes the energy consumed by implementing a multisensor target detection method.

Among all different types of sensors, video cameras are extremely powerful devices due to the great amount of contextual information that they are able to capture. Video-based human action recognition is therefore an alternative approach for nonintrusive recognition with immense potential. However, despite human's ability to understand effortlessly video sequences through observation, automatic video understanding is a delicate task that yet remains an unresolved topic [3]. One of the more challenging tasks faced by video-based approaches is the automatic annotation of video sequences for information retrieval. The work titled "*An efficient method for automatic video annotation and retrieval in visual sensor networks*" approaches this challenge applying sparse coding strategies. Specifically, the paper proposes a discriminative dictionary learning algorithm for video retrieval which is independent of video-specific scenarios.

Cognitive and understanding capabilities are the mechanisms that enable humans to succeed in identifying and recognizing the actions being carried in a certain context. In particular, the role of the language has been identified as crucial in the development of human reasoning. Given its importance, many have been the attempts to replicate these capabilities for natural language understanding in distributed systems and many are the subsequent challenges derived, such as the heavy computational load involved in meaning analysis. With this aim, the work titled "*Lightweight morphological analysis model for smart home applications based on natural language interfaces*" proposes a method for understanding contextual information based on a lightweight morphological analysis model that can be used for natural language interfaces in devices with memory or battery constraints.

Finally, the holistic approach pursued in this special issue is completed with the work titled "*Intelligent surveillance for understanding events in urban traffic environments*" in which a distributed surveillance system is proposed that is not only able to understand the ongoing situation but also undertakes the most appropriate response when an abnormal situation has been detected over a camera network.

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