Expert Systems

Editorial

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Intelligent monitoring for people assistance and safety

This expert systems special issue on 'Intelligent Monitoring for People Assistance and Safety' contains the revised and extended best papers dealing with different issues concerning people assistance and safety through intelligent monitoring and activity interpretation, presented at 'IWINAC 2011: the fourth International Work-Conference on the Interplay between Natural and Artificial Computation'.

People assistance and safety is a hot topic and of crucial importance in indoor environments such as homes, offices, hospitals and schools as well as in outdoor areas. Environments are increasingly well equipped with multiple sensing technologies that can monitor simple and complex activities and behaviours (Gascueña and Fernández-Caballero, 2011). Intelligent monitoring implies not only the analysis of the data captured from the various sensors but also their interpretation from the detection of the presence of certain events or actions previously defined (Rivas, Martínez-Tomás and Fernández-Caballero, 2011).

From a historical perspective, it is acknowledged that the evolution of monitoring systems has gone through three generations. In the first generation (1960–1980), closed-circuit television analogue systems were used, which consisted of several cameras connected to a series of monitors. These systems do not process information and require a human operator to be permanently concentrated on analysing the situations observed on the monitors. However, in the second generation (1990–2000), advances attained in digital video communication (e.g. digital compression, bandwidth reduction and robust transmission) were used to increase the efficiency of monitoring systems: closed-circuit television systems were combined with computer vision technology to process images automatically, in order to be proactive in the detection of alarm events during recording. These semi-automatic systems required a robust tracking and detection algorithm for behaviour analysis. Whereas these systems represented a clear improvement with respect to first generation systems by reducing the dependency on human operators to detect anomalous situations, their algorithms and techniques were responsible for triggering a high number of false positives.

In the third generation (2000-today), a series of heterogeneous sensors (e.g. fixed cameras, pan-tilt-zoom (PTZ) cameras, audio sensors and RFID tags (radio-frequency identification) will be geographically distributed throughout the scenario to be observed. From the image processing point of view, these systems are based on distributed processing capabilities and the use of embedded signal processing devices to gain distributed scalability and robustness. The main problems that need to be solved in third generation systems are the integration of data obtained from different sensors, establishing a correspondence of the signals in time and space and coordinating and distributing the processing task and video communication.

The papers

The papers selected in this special issue cover different layers present in modern intelligent monitoring systems (Micheloni *et al.*, 2010), namely, the sensor layer (sensors and networks) and the surveillance layer (feature extraction, recognition, tracking and event analysis).

A surveillance layer is described in two papers covering the aspect of human action/activity recognition. The proposal on 'Human Activity Recognition based on Kinematic Features' (Hernández *et al.* 2014), introduces a novel approach to recognise human actions in 2D sequences. It is based on the real-time visual tracking of people and the extraction of simple features. The paper proposes three complementary modules for the classical monitoring problems associated to (a) tracking; (b) feature extraction; and (c) action recognition. Tracking is based on the hybridisation of a particle filter and a local search procedure. Feature extraction characterises the silhouette of the tracked person by dividing it into several horizontal rectangular boxes. Then, the system computes statistics on the temporal evolution of these rectangular boxes. Lastly, action recognition uses these statistics into a support vector machine to classify the actions. Another paper, 'Human Action Recognition with Sparse Classification and Multiple View Learning' (Cilla *et al.*, 2014), employs multiple camera viewpoints in the recognition of human actions to increase the performance. The authors present a feature fusion approach to efficiently combine the 2D observations. Multiple view dimensionality reduction is employed to learn a common parametrisation of 2D action descriptors computed for each one of the available viewpoints. Canonical correlation analysis and their variants are employed to obtain such parametrisations. A sparse sequence classifier based on L1 regularisation is proposed to avoid the problem of having to choose the proper number of dimensions of the common parametrisation.

On the other hand, two papers are related to sensors and sensor networks. The first work, 'Learning Routines Over Long-Term Sensor Data Using Topic Models' (Castanedo *et al.*, 2014) faces the issue of the large amount of data generated by sensor networks when used as infrastructure to create intelligent environments. In this paper, topic

models are employed to learn the latent structure and the dynamics of sensor network data in order, efficiently to analyse data with the aim of learning and discovering what is happening in the monitored environment. Lastly, the paper 'Ambient Assisted Living System with Capacitive Occupancy Sensor' (Fernandez-Luque *et al.*, 2014) introduces an Ambient Assisted Living system that allows inferring a potential dangerous action of an elderly person living alone at home. This inference is obtained by a specific sensitisation with sensor nodes and a reasoning layer embedded in a personal computer that learns of the users' behaviour patterns and advices when the current one differs significantly of the normal patterns. In this paper, a force-capacitive transducer-based sensor is implemented and tested. This sensor is based on electromechanical films transducer, which is able to detect force variations in a quasi-passive way.

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References

Castanedo, F. López-de-Ipiña, D. Aghajan, H. K. Kleihorst, R. (2014) Learning routines over long-term sensor data using topic models, *Expert Systems*, Special issue on "Intelligent Monitoring for People Assistance and Safety", **31**, 365–377.

Cilla, R. Patricio, M. A. Berlanga, A. Molina, J. M. (2014) Human action recognition with sparse classification and multiple view learning, *Expert Systems*, Special issue on "Intelligent Monitoring for People Assistance and Safety", **31**, 354–364.

Fernandez-Luque, F. J. Martínez, F. L. Domenech, G. Zapata, J. Ruiz R. (2014) Ambient assisted living system with capacitive occupancy sensor, *Expert Systems*, Special issue on "Intelligent Monitoring for People Assistance and Safety", **31**, 378–388.

Gascueña, J. M. Fernández-Caballero, A. (2011) On the use of agent technology in intelligent, multisensory and distributed surveillance, *The Knowledge Engineering Review*, **26**, 191–208.

Hernández, J. Cabido, R. Montemayor, A. S. Pantrigo, J. J. (2014) Human activity recognition based on kinematic features, *Expert Systems*, Special issue on "Intelligent Monitoring for People Assistance and Safety", **31**, 345–353.

Micheloni, C. Remagnino, P. Eng, H. L. Geng, J. (2010) Intelligent monitoring of complex environments, *IEEE Intelligent Systems*, **25**, 12–14.

Rivas, A. Martinez-Tomás, R. Fernández-Caballero, A. (2011) Multiagent system for knowledge-based event recognition and composition, *Expert Systems*, **28**, 488–501.

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