# Context-Aware MAS for Remote Elderly Care

**Boštjan Kaluža**[1,3] , **Violeta Mirchevska**[2,3], **Erik Dovgan**[1,3]

[1] Department of Intelligent Systems, Jožef Stefan Institute, Ljubljana, Slovenia

[2] Result d.o.o., Bravničarjeva 11, 1000, Ljubljana, Slovenia

[3] Jožef Stefan International Postgraduate School (New Media and E-science, 2nd year)

`{bostjan.kaluza, violeta.mircevska, erik.dovgan}@ijs.si`

The population of developed societies is rapidly aging and there is an increased pressure on the working-age population to take care for the elderly people. Several systems were introduced in recent years addressing some issues related to this problem. However, most of the systems developed in this context are based on pre-defined fall detection [1, 4, 5], meaning that they are capable of recognizing simple hazardous situations and triggering alarms. We aim at augmenting the scope of detection and user-adaptation of the system by enriching it with more complex schemes for reconstruction, interpretation and adaptation. In particular, we are exploring the possible applications of intelligent agents in home environment, studying how they can be employed to realize cognitively-enhanced multi-agent system (MAS) which is capable of robust and reliable monitoring the elderly person in his or her daily activities. Not only the elderly will profit from the system, but also their families and caregivers, since the burden on them will be substantially reduced.

In this context, our efforts are endeavoring to integrate state-of-the-art technology in the fields of multi-agent systems, filtering, machine learning and outlier detection in order to produce a single, multi-functional system to be deployed in a home environment. The system is composed of a multitude of agents that are arranged hierarchically, providing increasingly more abstract situational awareness, and in parallel, exploiting the principle of multiple knowledge. We present the following groups of agents: the *refining* agent group where the agents filter noise, compute derived attributes and map raw data with the human body model; the *reconstruction* agent group, a set of agents which reconstruct a user's 3D position and a posture in the environment [3]; the *interpretation* agent group, which provides the awareness by explaining the reconstruction results and reacts to emergency or hazardous situations when detected; the *prevention* agent group, a swarm of agents monitoring a variety of measurable user parameters ranging from posture characteristics to daily activities, and reacts to contingencies and foreseeing inconsistencies in the user's behavior indicating a decreased psychophysical state or even a disease; and finally, the *cognitive* agent group which is able to construct the cognitive state of the integrated system from increasingly more abstract context awareness, and perform reasoning on a wider spectrum of information with an integrated reasoning strategy.

The system has been tested in several on-line demonstrations. The results in the fall detection experiment showed that context dependent reasoning can detect the complex scenarios usually misinterpreted by acceleration-based systems [2]. In addition, the preliminary results on disability detection are encouraging, showing a potential for premature discovery of a potential health problem that may lead to a perilous condition.

References:

[1] A. K. Bourke and G. M. Lyons. A threshold-based fall-detection algorithm using a bi-axial gyroscope sensor. *Medical Engineering & Physics*, 30(1):84–90, 2008.

[2] Bostjan Kaluza, Violeta Mirchevska, Mitja Lustrek, Igone Velez, and Matjaz Gams. Ubiquitous care system to support independent living: Preliminary results. In: *Roots for the future of amb. intelligence*, pp. 308–315, 2009.

[3] Mitja Luštrek and Boštjan Kaluža. Fall detection and activity recognition with machine learning. *Informatica*, 33(2):197–204, 2009.

[4] J. I. Pan, C. J. Yung, C. C. Liang, and L. F. Lai. An intelligent homecare emergency service system for elder falling. In: *World Congress on Medical Physics and Biomedical Engineering 2006*, pp. 424–428, 2006.

[5] T. Zhang, J. Wang, J. Liu, and P. Hou. Fall detection by wearable sensor and one-class SVM algorithm. In: *Lecture Notes in Control and Information Science*, pp. 858–863, 2006.