

# **Solutions regarding Intelligent Embedded Systems for Active and Assisted Living**

## **HABILITATION THESIS**

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### **Abstract**

This work presents my research activity since I publicly defended my thesis and I obtained the Ph.D. title from the “Politehnica” University of Timisoara (2005). During this time I participated in more than 15 research and educational contracts and grants. As a result of my research activity I published in this period a total of 68 scientific papers including 3 in ISI journals with impact factor, 25 in conference proceedings indexed by ISI and 32 articles indexed in prestigious international databases. Also I published a book chapter related to the subject of my thesis in Springer Lecture Notes in Computer Science with the title ”Application Possibilities of Hardware Implemented Hybrid Neural Networks to Support Independent Life of Elderly People”, 2 books in national publishing houses and I have also developed 3 teaching materials available in electronic format.

The first section of the manuscript entitled “Scientific achievements”, reviews my contributions to the development of intelligent embedded systems for active and assisted living (AAL).

These contributions are grouped into three research directions, which are presented each in a separate chapter of this thesis:

- Hardware implementation of artificial neural networks (ANN) using field programmable gate arrays (FPGAs) and applications development based in this method.
- E-Health and Ambient assisted systems, grouped around three sub-topics:
  - Ambient intelligent systems
  - Wearable systems for activity and health monitoring
  - Robots for personal assistance
- Contributions to development of new methods for activity recognition using combination of features extraction techniques and the use of neural networks for pattern recognition.

Chapter 1 presents the main contributions of the thesis related to the first direction of research, the development of the method proposed in my PhD work on the implementation of artificial neural networks in programmable circuits (FPGAs) and development of applications using this method. There are presented the achievements on the implementation of Feed-Forward (FF) neural networks

reported in [6], [7], and [8], competitive networks [9] and [10], neural networks with on-chip learning [8] [11], [13], [14], [15], [16]. Hardware implemented neural network applications for hand gestures recognition were published in [26], [27], [28], [29]. Other applications developed refer to an artificial olfactory system presented in [30], intelligent man-machine interfaces [32] or intelligent sensors [6]. Other contributions related to this subject are: sigmoid function hardware implementation on FPGA circuits [19], and a new C++ implemented feed forward neural network simulator [134]. Among this articles 8 are ISI indexed and 8 indexed in other international databases.

My contribution to the second theme were related to three sub-topics: Ambient intelligent systems results being published in [34], [38], [43], [45] [46], wearable systems for activity and health monitoring [33], [46], [47], [48], [54], [55], [57], [58], [59] and respectively development of robots for personal assistance [72], [73], [74], [75], [76], [77] respectively. Four articles are indexed by ISI and 12 in other international databases.

In the third direction of research my contributions are related to modeling in Matlab environment the human activity recognition systems [47], [48], [80], [81]; Human activity and health status recognition [111], [112] and studies regarding optimal recognition methods of human activity [113], [114]. This achievements were disseminated trough 2 ISI indexed journals and 3 at conferences with proceedings indexed by ISI (one accepted for publication).

My scientific contributions have a good visibility being cited in more than 270 scientific papers and books, 52 citations being in ISI indexed journals or conferences, books or PhD. thesis (excluding auto-citations).

The second section describes my professional achievements, presenting my main collaborators, my contributions regarding initiations and coordination of new study programs in Romania and abroad, development of new courses at B.Sc., M.Sc., and Ph.D. level, initiation of academic and research collaborations with Romanian and international partners, achievements in teaching activities and supervision of thesis at B.Sc., master, and PhD level. The grants and research projects that I leaded or I was involved in as a member of the research team are also presented.

Part three dedicated to the career evolution and development plan outlines my vision regarding the evolution of my academic career. It indicates the objectives pursued and the associated actions on the didactic component and the research component respectively. The fundamental and applied research direction that I envision, the perspectives on increasing the visibility of my research results, increasing the

impact of my scientific publications, leading or participating into international educational and research projects, are also being presented here.

The final part includes a list of references with 136 titles which lists 48 of my publications related to the topics of this thesis.