

Advances in technologies and techniques for ambient intelligence

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Human activity is attracting a lot of research activity in several fields including the use of wireless sensors, positioning technologies and techniques, embedded computing, remote sensing and energy management among others. There are a number of applications where the results of those investigations can be applied, including ambient intelligence to support human activity, particularly the elderly and disabled people. Ambient intelligence is a new paradigm for the information and communications technologies where the electronic/digital environment takes care of the people presence and their needs, becoming an active, adaptive and responsive environment.

The research activity on the creation of active environments which are sensitive to the presence of people and their particular activity is gaining a great relevance due to the potential benefits which offers to improve the quality of life. The invention and deployment of those environments includes the design and implementation of appropriate electronics, the creation of friendly interfaces which allows

the interaction in easy, natural and comfortable ways. Part of the research activity is aimed at developing easily living electronic environments as well as systems responding to people needs, personalized and in an anticipatory way. Apart from the electronics embedded in the environment appropriate wearable devices must be designed to provide an actual interaction.

The development of real ambience intelligence implies that the overall processing power is distributed and embedded in the environment. Nonetheless people are now in the forefront of the development of ambient intelligence; wired and wireless distributed computing are a key mean to the consecution of the established goals.

This special issue is aimed at covering some of the key research activities in technologies and techniques for ambient intelligence, including indoor accurate positioning, development of ambient intelligence embedded computing systems, remote sensing and energy management based on people activity.

Location-based services and applications supported by location technologies are becoming essential in human activities. Outdoor localization is currently supported by the GSM system which provides an appropriate accuracy for general applications. The future European Galileo system will provide outdoor satellite navigation with a proper accuracy for navigation applications. Nevertheless there are a number of applications which requires positioning capabilities with indoor coverage and higher resolutions. New technologies, techniques and algorithms are being developed to cover the need for indoor positioning and navigation with the appropriate accuracy.

In many ambient intelligence applications and services location is an indicator of the context in which people and devices are immersed and the way in which the elements in the environment must act, establishing interaction rules

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depending on the position and state of the various agents in the environment. The achievement of an appropriate performance requires the proper position computation accuracy.

This special issue includes the advances in location systems with cm accuracy and precision for ranges around 10 m which involves the development of an appropriate estimation algorithm. It constitutes a promising system to implement real ambient intelligence. Furthermore, location-dependent services require ambient intelligence location-plus-tracking capabilities. To cope with this problem the combination of wearable devices (accelerometers) with tracking seems to be a good solution, as described in this special issue.

The improvement in technologies and technologies for indoor positioning can be used for both people and goods/appliances localization. Furthermore, the achievement of systems offering higher accuracies will provide appropriate turn by turn guidance in places where satellite based systems are not useful, i.e., the interior of buildings.

The advances in ambient intelligence are also powered by the improvements in the development of embedded systems. Fast object detection is a key characteristic in ambient intelligence which improves the real-time scalability of systems. The appropriate selection of RTOS and programming languages can simplify and accelerate the implementation of ambient intelligence with better performances and improved interactivity. OpenCL is a promising programming language appropriate for distributed computation as ambient intelligence require. From the OpenCL perspective ambient intelligence is a computing system composed of a number of devices with computation capabilities aimed at different purposes which provides high integration capabilities. OpenCL easily exploits the parallelism required to successfully deploy ambient intelligence systems. A good example of the OpenCL usage included in this special issue is the fast implementation of a robust object detector where parallelism is exploited to decrease the processing time.

Remote sensing technologies are playing a relevant role in ambient intelligence. In particular, due to the potential social impact of these technologies and techniques in the quality of life of a large research activity on health monitoring is ongoing. In this special issue a high performance image reconstruction systems which includes appropriate optimized algorithms and high performance embedded computing is introduced. The system has demonstrated its use in remote sensing.

Another relevant issue in ambient intelligence concerns energy management. Human activity involves energy consumption which is a limited resource, particularly in mobile devices, and a special care must be taken. Lights, screens, windows, heating, air conditioning and other devices/appliances can be managed depending upon people activity and environment conditions. This special issue includes the investigations on ontology-based office activity recognition with applications for energy savings that effectively handles multiple-user, multiple-area situations, rapidly recognizing office activities. Ambient intelligence can be used to monitor human activity to appropriately control the appliances to combine power saving and comfort feeling.

Further research is aimed at the improvement of ambient intelligence systems. Additional efforts on wireless sensors, location technologies, embedded computing, friendly interfaces, energy management, trust, security and supporting algorithms must be performed in order to ensure the success of the potential applications.