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EDITORIAL

Guest editorial introduction to the special issue on biometric interfaces between ambient intelligence and augmented cognition

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Ambient intelligence integrates computational intelligence into ubiquitous/pervasive computing environments and artifacts. Computers become embedded in our natural surroundings. They move to the background to better provide smart services to humans who perform into the foreground. The humans are helped by simple and effortless interactions, with computers attuned to all their senses, adaptive to their profile and context-sensitive, autonomic and last but not least secure and trustworthy. High-quality computing, communication and quality of service (QOS) access and personalized content must be available to everybody not only at anyplace, anytime, but even more importantly, at the right place, right time and by the right means. This fundamental view changes drastically the development of new technologies, focusing on bringing "digital intelligence" to future electronics products. The objective is to create and deliver new technologies that are more intuitive, intelligent and "human," in order to allow the delivery of products that are easier to use and thus more helpful for people.

Human authentication in ambient intelligence should preferably not be bound to voluntary or conscious user's interactions with recognition equipment, but rather it should rely on the ability of an underlying control system to automatically and autonomously capture user's characteristics and use them for identification, verification, and/or surveillance. Biometrics involves the automated authentication from personal physical appearance or behavioral traits. It further provides the needed context and personalization to interface and mediate between ambient intelligence and augmented cognition. Biometrics makes use of different sensory mechanisms to assess both identity and physiological (physical and cognitive) state. Augmented cognition extends users' abilities in order to improve their performance and to provide for graceful degradation. Augmented cognition can parse both covert and overt communication, and it supports context switching. Augmented cognition provides the upper management layer needed to (a) make appropriate choices for bandwidth, context, and specific functionality; (b) adapt, prioritize and coordinate; (c) reduce the effects of cross-talk ("modal") interference; and (d) handle in a flexible way time-varying inputs. Note that both the computer and the human subject have their "cognitive" abilities augmented to enhance their performance. Towards that end, one needs closed-loop control and reliable biometric interfaces, which are aware of subjects' abilities, behaviors, emotions, intensions, and/or immediate needs and responds accordingly. There is feedback, the biometric interface is adaptive, and anticipation is driven by predictions. Both context and the subjects' (mental and physical states) models are attended to or inferred to leverage the connections between personal appearance, cognitive state, and behavior, in order to deliver smart services and logistic support.

Though there has recently been a great deal of progress in biometrics, their use as interfaces between ambient intelligence and augmented cognition still lags behind. There is, however, a growing need to determine in a robust fashion both the physical and cognitive state of human subjects. This need is due, among other, to an aging population that requires health care management, intelligent infrastructures to alleviate cognitive overload, e.g., air traffic control and intelligent highways, education and training, and social networks. Towards that end, biometrics can assess among others awareness (vs. confusion), involvement and interest, understanding, and inner feelings and emotions, e.g., such as satisfaction.

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This special issue is dedicated to recent progress in the use of biometrics as interfaces between human subjects and computer avatars. It explores emerging themes such as health care management, geriatric care and surveillance, cognitive state and safety, face expression and disposition, intent and social networking, infant care, apprehension, contents understanding, subject profiling, and collaboration and recommendations. Towards that end, this special issue includes six representative papers selected after a careful review process and timing constraints. Each of the papers present a somewhat different point of view as we believe that diversity of approaches needs to be nurtured and commended, because it helps keeping this field of research lively and moving forward.

Behavioural biometrics find a special niche in the case of Assisted Living, in which individuals suffering from various diseases at different stages need supervision in their daily activities as they cannot function on their own and need assistance. Within this context, the paper "Case-based Approach Using Behavioural Biometrics Aimed at Assisted Living", by S. Xefteris1, V. Andronikou, K. Tserpes and T. Varvarigou, focuses on a future scenario where smart interfaces integral to the "InLife" system, unobtrusively support daily life activities of elderly people. The architecture incorporates emotion classification, movement detection, person identification, pattern and activity recognition techniques, all integrated in the elderly personal environment.

Several approaches have been proposed to improve biometric systems performances in ambient intelligence. However, such systems are usually penalized from the intrinsic limitations of the adopted classification techniques. Multiagent architectures (either multibiometric or multiclassifier) resolve some problems but still suffer from the lack of communication among subsystems and from the lack of invariance of their parameters. The second paper "MUBAI—Multiagent Biometrics for Ambient Intelligence", by A. F. Abate, M. De Marsico, D. Riccio and G. Tortora, introduces a new architecture, aiming at overcoming such problems using a collaboration protocol and supervisor module, and finally adopting an effective unsupervised training algorithm.

Watermarking is a steganography technique, which can be included in the Information Fusion methods, and makes it possible to insert in a file, e.g., a photo or video, a textual marker that lets one know about its ownership and copy rights. Many approaches have been proposed to improve watermarking systems. The paper "Image Watermarking via Wavelet Approach and Face Biometrics", by G. Iovane, P. Giordano, S. D. Borysenko, presents a new high-performance system for tracking the access to a file and for establishing the copy rights by using information fusion (IF) techniques based on face biometrics (FB) and wavelet multiresolution analysis (WMA).

In order to reduce both psychological and physical stress in air travel, sensors are integrated into airplane seats to detect gestures as input for in-flight entertainment systems. The paper "Integrating Gesture Recognition into Airplane Seats for in-Flight Entertainment", by R. van de Westelaken, J. Hu, H. Liu, M. Rauterberg, shows an entertainment systems that would help to reduce psychological stress, using gestures as input for interaction, to stimulate people to move and reduce their physical stress.

There is always a deep concern about the introduction of new technologies which may impact on personal privacy. The paper "Biometrics in Ambient Intelligence", by M. Tistarelli and B. Schouten, analyzes the potential of biometric technologies within the general scope of ambient intelligence, trying to identify some key technological issues which may arise due to privacy concerns. Some example applications are considered where by exploiting the information contained in biometric data, such as the facial expression or other, non visual, measurements, it is possible to better immerse the user within her environment in order to provide the needed feedback to drive and recommend the services provided without compromising his privacy.

The person reidentification problem arises in many surveillance applications, where it is desirable to determine if a given individual has been previously observed over a network of cameras. The paper "Appearance-based person reidentification in camera networks: Problem overview and current approaches", by G. Doretto, T. Sebastian, P. Tu, J. Rittscher, focuses on several algorithms that use the overall appearance of an individual as opposed to passive biometrics such as face and gait.

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