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EDITORIAL

Ubiquitous computing for health applications

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1 Introduction

It is now 30 years since Marc Weiser first coined the term "ubiquitous computing". In his extraordinary conception, the then chief scientist at Xerox PARC came up with a set of principles that would regulate the role and shape of computers in the twenty-first century. According to Weiser's vision, computers should "help to do something else", "be quiet invisible servants", "extend our unconscious", and "create calm". This was nicely summarised in the famous introductory paragraph of his most renowned article (Weiser 1991): "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it".

It is fair to say that Weiser's vision has driven the evolution of technology to a large extent. Ubiquitous computing in particular has changed quite a lot over the years, and it has proven to be a reference field in technology, helping to develop new revolutions such as the internet-of-things. What makes, perhaps, ubiquitous computing a field of special interest is the fact that it combines very well with multiple application domains. One main domain is healthcare, an area growingly in need of smart and efficient solutions to deal with the current and future societal demands. Ubiquitous technology is already enabling the implementation and administration of personalized health and wellbeing services, which intelligently react and adapt to the ever-changing needs of users. In doing so, this field addresses a wide range of challenges, including but not limited to disease monitoring, support diagnosis, or coach on wholesome behaviours, among others.

In this special issue we collected various interesting works describing some of the latest research and development achievements in ubiquitous computing for health and wellbeing applications. We have clustered them around three main health and wellbeing aspects these works delve into respectively: physical behaviour, cognitive and emotional behaviour, and social behaviour.

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2 Physical behaviour

The analysis of human physical activity has been a relevant subject of study in the ubiquitous computing area. Particularly boosted by the advent of wearable technology, the measurement and characterisation of gait patterns has for example been shown of key importance in the identification of motor impairments. In "Relationship between stride interval variability and aging: use of linear and non-linear estimators for gait variability assessment in assisted living environments" (Gonzalez et al. 2017), the authors analyse the changes in the gait cycle of physically independent older adults. To do so, they collect data from a wearable inertial sensor placed on a group of elders' and adults' trunk, which is later analysed using non-linear fractal analysis and a linear estimator. The authors show in their work that stride interval divergence appears to be more correlated with locomotor impairments than aging.

On a more practical note, the authors of "SPIRA: an automatic system to support lower limb injury assessment" (Bailon et al. 2018) describe a video analysis tool that can be used support practitioners during the evaluation of functional biomechanics tests. The proposed system uses a low-cost infrared camera and retro-reflective markers attached to the user's body joints to robustly track and measure the joint angles in real time. The authors show that their tool compares to the gold standard used by most practitioners, while expediting dramatically the assessment time.

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Data science and artificial intelligence are with no doubt key enablers of the new generation of ubiquitous technologies. The success of these technologies thus largely depends on the model design process. For example, the choice of features has a high impact on the performance of the classification model. This is particularly true for activity recognition models, which are normally based on discriminative features describing the dynamics of the sensor data collected from users. In "Methodology for improving classification accuracy using ontologies: application in the recognition of activities of daily living" (Salguero et al. 2018) the authors present a semantics-based approach to improve the accuracy of general activity recognition models. Such approach creates richer feature vectors compared to those defined by domain-experts, especially when the data has some kind of unknown underlying structure or the possibilities are unnumbered.

3 Cognitive and emotional behavior

Mental health is becoming a hot topic in ubiquitous computing. One main challenge is to measure cognition, i.e. mental processes, in an effective and unobtrusive way. In "MobileCogniTracker—a mobile experience sampling tool for tracking cognitive behavior" (Wohlfahrt-Laymann et al. 2018) the authors address this challenge through a mobile tool that allows for the creation, administration and remote execution of digitised cognitive assessment tests, being potentially used to detect cognitive decline. A different approach to collect and analyze cognitive measurements is explored in "Analyzing EEG waves to support the design of serious games for cognitive training" (Mondejar et al. 2018). Here, the authors provide interesting findings on how video game mechanics exercise specific abilities, in terms of EEG frequency responses, to support the design of serious games for cognitive training and rehabilitation.

Close related to cognition are the studies on human emotions. In "Affective state detection via facial expression analysis within a human–computer interaction context" (Samara et al. 2017) the authors propose a hierarchical ensemble model to classify affective state through facial expressions. The developed system evidences that facial expressions cannot precisely reveal the actual feelings of users whilst interacting with common computerised tasks.

One critical aspect related with human affects is the motivation. Even successfully developing health applications, they can fail because of the patient's lack of motivation. In "Influence awareness: considering motivation in computer-assisted rehabilitation" (Lopez-Jaquero et al. 2017) the authors aimed at filling this gap through a model termed "Influence Awareness". This model supports the specification of motivation aspects in applications used in computer-assisted rehabilitation where designers get some extra guidance on various heuristics on how to design motivation.

4 Social behaviour

Apart from physical and mental aspects, the social dimension has a huge influence on them. In "A multi-site study on walkability, data sharing and privacy perception using mobile sensing data gathered from the m^k-sense platform" (Hernandez et al. 2017) the authors present a tool that facilitates the deployment of collaborative sensing campaigns for conducting cross-cultural studies and collect social-related measurements. The authors also report on various studies conducted across four different countries, namely Mexico, Turkey, Spain, and Switzerland, with a total of 77 participants. Another approach that explores social dimension, in this case related to support social integration of elderly people, is described in "Assembling mass-market technology for the sake of wellbeing: a case study on the adoption of ambient intelligent systems by older adults living at home" (Gutierrez et al. 2017). This proposal is focused on the development and validation of the system called "SocialConnector", a computer-supported family communication mediator.

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References

Bailon C, Damas M, Pomares H, Banos O (2018) SPIRA: an automatic system to support lower limb injury assessment. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-018-0722-6

Gonzalez I, Fontecha J, Bravo J (2017) Relationship between stride interval variability and aging: use of linear and non-linear estimators for gait variability assessment in assisted living environments. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-017-0608-z

Gutierrez FJ, Munoz D, Ochoa SF, Tapia JM (2017) Assembling mass-market technology for the sake of wellbeing: a case study on the adoption of ambient intelligent systems by older adults living at home. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-017-0591-4

Hernandez N, Arnrich B, Favela J, Ersoy C, Demiray B, Fontecha J (2017) A multi-site study on walkability, data sharing and privacy perception using mobile sensing data gathered from the m^k-sense platform. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-017-0642-x

Lopez-Jaquero V, Montero F, Teruel MA (2017) Specifying how to motivate people in computer assisted rehabilitation. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-017-0652-8

Mondejar T, Hervás R, Johnson E, Gutierrez-Lopez-Franca C, Latorre JM (2018) Analyzing EEG waves to support the design of serious

games for cognitive training. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-018-0841-0
Salguero AG, Medina J, Delatorre P, Espinilla M (2018) Methodology for improving classification accuracy using ontologies: application in the recognition of activities of daily living. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-018-0769-4
Samara A, Galway L, Bond R, Wang H (2017) Affective state detection via facial expression analysis within a human–computer interaction context. J Ambient Intell Hum Comput. https://doi.org/10.1007/s12652-017-0636-8
Weiser M (1991) The computer for the 21st century. Sci Am 265(3):94–105
Wohlfahrt-Laymann J, Hermens H, Villalonga C, Vollenbroek-Hutten M, Banos O (2018) MobileCogniTracker—a mobile experience sampling tool for tracking cognitive behaviour. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-018-0827-y