Journal of Ambient Intelligence and Humanized Computing
https://doi.org/10.1007/s12652-022-04474-9

EDITORIAL

Ambient intelligence for self-care and self-management

Ramón Hervás[1] · Oresti Baños[2] · Claudia Villalonga[2]

1 Introduction

Healthcare systems are dealing all over the globe with draining resources at a time when demand for healthcare services and assistance is rapidly rising. As a consequence, public administrations are facing a growing pressure to decrease costs without impacting quality or access to care. Modern technologies emerge in this context as a key driver of change and a potential solution to healthcare's resource problems. For example, AI-based analytic tools can provide more precise patient diagnosis and disease detection leading to greater value in clinical services, higher patient adherence, and better health outcomes. The use of digital technologies is also changing the way consumers access and receive care, with a clear shift from inpatient care to outpatient service. At the forefront, IoT devices and apps are increasingly supporting greater patient engagement in their own care, with patients monitoring their health at home with systems that report wirelessly and automatically to their physician or caregiver.

Ambient Intelligence (AmI) is one of the main technological paradigms supporting this radical shift in healthcare from professional to domestic settings. AmI, which broadly refers to electronic environments sensitive and responsive to the presence of people, has built over the years upon a variety of disciplines such as pervasive computing, ubiquitous computing, context awareness, and human-centric computer interaction to develop novel health-related solutions integrated in people's everyday life. For many of these solutions AmI plays an essential role while enabling personalized services that intelligently react and adapt the environment to the user health-related needs, with a measurable improvement of people's quality of life.

Current tendencies in the AmI paradigm aim to empower people in terms of self-care and promote proper self-management and healthy lifestyles. To meet this goal, it is essential to address important challenges related to continuous monitoring—to provide both users and practitioners with a new dimension of health-related data; integration of this data with cloud, fog, and edge computing and social networks—to share information and experiences with peer groups; or guiding people in the self-management of their conditions through intelligent coaching services—to ensure proper handling of diseases and care. In the light of these challenges, we proposed a special issue bringing together the latest experiences, findings, and developments to advance the progress of the AmI paradigm for self-care and self-management. The special issue accepted seven articles submitted by authors from Chile, Mexico, United Kingdom, Costa Rica, Spain, and China after undergoing a rigorous peer-review process. In the following, a summary of each contribution is provided for the reader.

2 Contributions

Diabetes is a very relevant disorder with a high prevalence worldwide. Diabetic patients, especially those suffering from the most severe complications, are responsible for self-managing their condition by maintaining a healthy diet, exercising regularly, and avoiding use of tobacco. In (Fontecha et al. 2019) the authors exploit the use of mobile phones to support the self-management of diabetes patients. They particularly study usability aspects of these systems, including concepts such as engagement,

✉ Ramón Hervás
Ramon.Hlucas@uclm.es

Oresti Baños
oresti@ugr.es

Claudia Villalonga
cvillalonga@ugr.es

[1] Department of Technologies and Information Systems, Modelling Ambient Intelligence Research Group, University of Castilla-La Mancha, Paseo de La Universidad 4, Ciudad Real, Spain

[2] Department of Computer Architecture and Computer Technology, Research Center for Information and Communication Technologies, University of Granada, Calle Periodista Rafael Gomez Montero 2, Granada, Spain

Published online: 07 November 2022

empowerment, and treatment adherence. As a result, the authors present a set of consolidated usability problems categorized by severity index, source, and other factors, with a special focus on the impact of these types of issues from the perspective of diabetic patients.

Job stress is also attracting much interest lately. In this direction, (Sanchez et al. 2018) propose an approach to recognize job stress in its initial stages or even before it arises, something that is identified by the authors as useful for both employees and employers. Their approach consists of a mobile monitoring system that combines data from a wrist-worn sensor and worker's self-reports. The collected data is intelligently processed using machine learning techniques to identify behavior patterns in a group of employees and their perception of job stress. The authors conducted a study with more than 50 subjects at various institutions. The predictive models trained on the collected data seem to show quite promising results in recognizing job stress.

People's daily endeavors can explain a lot about how we act as a collectivity. For example, discovering the top most interesting locations, detecting the most traveled routes, and identifying the principal hotspots and meeting points is of much value to (re)think urban areas. This becomes even more relevant in the light of existing worldwide challenges such as climate change or devastating pandemics. In (Salomon et al. 2018) the authors propose a methodology to detect behaviors by processing GPS trajectories and building probabilistic models. Their approach involves detecting visited points, identifying relevant locations, and finally constructing a stochastic model that represents the behavior of the user. With these models, the authors can discover the most relevant places the user visits and define specific mobility models.

Most frequently, the understanding of our behaviors is exclusively based on the analysis of our own actions. However, in some cases, we may require to also understand how our inner circle behaves to fully comprehend why we act the way we do. In (Macias et al. 2019) the authors explore this idea particularly within the context of children with disabilities. As the authors state in their work, one of the main factors affecting autonomy in children with disabilities is parents' behaviors. Hence, understanding parents' behaviors turns to be of much relevance, and apparently, it has remained a largely unexplored area in ubiquitous computing. The authors propose in this work the use of mobile sensing to monitor behaviors in parents of individuals with Down syndrome. They identified some behaviors reported to be associated with directive and facilitating behaviors and they also elaborate on how this mobile sensing-based approach can be used as a supplementary technique to enhance behavioral analysis with these groups.

Sensorized environments are becoming increasingly popular with the advent of the Internet-of-Things. More and more consumers buy regularly smart home devices intended for security, energy management, or entertainment among other applications. These devices are instrumented with sensors such as proximity detectors, pressure sensors, or temperature sensors that can be leveraged for measuring human behavior. In (Zhang et al. 2019) the authors employ these types of sensor data to automatically recognize people's daily activities. They particularly address the challenge posed by the intraclass variation between activities and reasoning from low-level uncertain information. To that end, the authors propose the use of a Radial Basis Function Neural Network and they focus on the generalization ability of the model by considering both the training error and stochastic sensitivity measure. They test their approach with three benchmark neural network architectures, and they evaluate them with a simulated dataset as well as various publicly available ambient sensor datasets. Their results show the importance of model generalization abilities as well as the limitations of deep neural networks when used in this type of ambient sensor-based activity recognition problems.

Collecting behavior data via hardware sensors is sometimes difficult if not impossible, especially when it comes to measuring mental aspects. In such cases, digital diaries seem to be interesting solutions to gather people's self-reports on how they feel or what they think. In (Rodriguez et al. 2019) the authors propose a digital diary application particularly targeted at older users. The study analyzes the challenges that seniors face while using this type of digital solutions, namely while recording specific actions and their emotions. The authors found in their study that older adults used the diary actively to reflect on their emotions, registering positive as well as negative ones. They also identified diverse needs and preferences for entering this information into the digital diaries (e.g., digital handwriting and voice dictation in addition to standard keyboard typing).

Finally, another trending challenge in self-care and self-management is to reduce the effort of creating, customizing and maintaining services that typically collect IoT data from heterogeneous sources. A possible approach is based on knowledge-based systems managed directly by prosumers without deep technical experience. In these terms, it is been studied the quality of services developed by prosumers, comparing them with services developed by experts (Sánchez-Picot et al. 2021). In this work, authors propose a prosumer-based framework named *DataQuest* to gather and process data through ontologies. This system was empirically validated using an Ambient Intelligence environment simulator where 18 domain experts and 12 developers participated.

Acknowledgements We would like to thank all the referees of this special issue for the high quality of their reviews.

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