EFFICIENT AND COST-EFFECTIVE COMMUNICATIONS IN UBIQUITOUS HEALTHCARE: WIRELESS SENSORS, DEVICES AND SOLUTIONS

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Ubiquitous healthcare means healthcare anywhere anytime, a dream not realized in most parts of this world. On the other hand, the cost of healthcare is increasing and may become totally unaffordable in view of the aging population in many countries. Hence, the world is exploring the means to enhance the reach of healthcare at lower cost. The recent developments in wireless sensor devices and applications provide a glimmer of hope in tackling this gigantic problem through telehealthcare, where part of the healthcare can be performed remotely over information and communication networks. Thanks to the progress in communication and information processing technologies (sensors, biosensors, wire and wireless communication, web semantics, smart phones, game consoles, etc.), ubiquitous healthcare could soon be a reality. It is also envisioned that the convergence of disciplines such as information and communications technologies (ICT), biotechnologies, and nanotechnologies will accelerate the innovation in the field, and open up new opportunities for miniaturization and large-scale production of efficient and affordable products in the future. Nevertheless, standardization will have an important role in ensuring interoperability between devices and information systems, a key factor for large-scale and cost-effective deployment of e-health systems.

This is the second and last issue of the Feature Topic on Communications in Ubiquitous Healthcare: Wireless Sensors, Devices and Solutions initiated in January 2012 with the publication of the first issue, which received a large number of submissions, demonstrating the tremendously growing interest in this field all over the world. Thanks to the Editor-in-Chief, we could accept some more papers that reflect additional cutting edge research and development trends in the area. Accordingly, this issue includes a collection of four additional articles covering four aspects of ubiquitous healthcare: context awareness communication and computing, body area network MAC layer challenges, mobility management, and, finally, practical issues in designing ubiquitous healthcare systems. Summaries of these articles are presented next.

The first selected article is "Research Challenges in Computation, Communication, and Context Awareness for Ubiquitous Healthcare" by Hariharasudhan Viswanathan, Baozhi Chen and Dario. In this article, the authors envision a ubiquitous healthcare solution around a collection of powerful devices in the vicinity of a wirelessly connected local mobile computing grid. Vital sign data are prioritized using the computational capability of this mobile grid and transmitted wirelessly to a back-end healthcare provider. The data can be locally stored on the sensor nodes and analyzed offline later using powerful processing devices such as a computer or smart-phones in a delay-tolerant fashion. Alerts and reports of early diagnosis can be made available to health workers through a remote online electronic health record database. A key advantage of this approach is that it is possible for health workers to analyze the stored data from multiple subjects under geographic and demographic context and reveals some interesting patterns of endemics/epidemics that would help timely launch medical interventions when needed.

The second article, "Challenges in Body Area Networks for Healthcare: The MAC," is authored by Athanassios Boulis, David Smith, Dino Minuitti, Lavy Libman, and Yuriv Tselichshev. In this article the authors discuss the important challenges in designing BAN MAC and the importance of fully understanding the physical channel in body area networks. They first outline the current state of the art in the proposed standard's MAC as well as additional techniques that can be used to achieve higher reliability and efficiency. Following this state of the art, they derive various specific challenges for MAC operation in BAN toward eHealthcare and highlight specific ongoing challenges that are addressed in the IEEE 802.15.6 draft standard for BAN. Therefore, they proposed several novel techniques to efficiently provision resources in the BAN such as smart management of outages and retransmissions or optimal usage of relay nodes. The investigated techniques take benefit of cross-layer optimizations to share information between the physical and MAC layers to

improve the overall system performances and also to take benefit from temporal correlation that exists between link states in the MAC. The overall solution shows significant performance improvement.

The third article is "Toward Ubiquitous Mobility Solutions for Body Sensor Networks on HealthCare" by J Caldeira, João, Joel Rodrigues, and Pascal Lorenz. This article addresses the problem of patients' mobility in the hospital and to improve their quality of life by not constraining them to remain in a confined space. When a monitored patient moves outside his/her room, wearable devices may lose their connections and the patient may be in danger. To ensure ubiquitous monitoring of their status, the authors propose a ubiquitous mobility solution for healthcare wireless body sensor networks that uses the 6LoWPAN standard. The solution implements a novel mobility protocol that aims to ensure continuous access to mobile nodes that are already known by APs and minimize the registration process of nodes that came into an AP covering a geographic area for the first time. This is to reduce energy consumption of wearable devices, which is a crucial technical characteristic in the long run.

The last article is "KNOWME: A Case Study in Wireless Body Area Sensor Network Design," authored by Urbashi Mitra, Adar Emken, Sangwon Lee, Ming Li, Viktor Rozgic, Gautam Thatte, Harsh Vathsangam, Daphney Zois, Murali Annavaram, Shrikanth Narayanan, Donna Spruijt-Metz, and Gaurav Sukhatme. This article presents a set of lessons learned from developing and experimental platform for ubiquitous healthcare called the KNOWME platform. The authors highlight throughout the article the various problems they have faced and the solutions they have proposed from system integration, optimization, and in-field deployment of the platform for pediatric obesity management. Their experiences have revealed that a high performance WBAN design is possible employing a modest number of heterogeneous sensors however many specific aspects such as those related to communications interferences, devices energy consumption, activity detection accuracy, wearable devices comfort are not fully solved and require further studies before being able to widely deploy them in the society.

BIOGRAPHIES

NAZIM AGOULMINE (nagoulmine@ieee.org) is a full professor at the University of Evry, France. He is leading a research group on networking and multimedia systems as part of the the IBISC Research Laboratory. His research activities encompass fixed and wireless networks, autonomic network management, WSN, medical BAN, nano-communications, and so on. Since 1989, he has been involved in several research projects on ICT funded by the European commission Framework programs FP5/FP6/FP7 (Advance, Pemmon, Forms, ICM, Adanets, Seimonet, Sumo, Wellcom, Expeshare) and the French government (Cesame, Amarrage). He is nowadays the secretary of the eHealth Technical Committee at IEEE Communication Society and the general TPC co-chair of Healthcom 2012. He has published more than 100 conference papers, books and book chapters, and refereed journals in the areas of wire and wireless networks management, WSN, WBAN, QoS/QoE, autonomic networking, etc. More details are available at Nazim's home page (weblrsm.ensiie.fr/Nazim).

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