Guest Editorial: Challenges of Embedded Systems as They Evolve into M2M, Internet of Things

With the rapid progress in information communication technology (ICT), multidisciplinary research fields such as Internet of Things (IoT), machine to machine (M2M), and embedded systems have been widely explored in recent years. As a result, a wide range of research opportunities have surfaced, with new challenges and research issues in IoT areas to be investigated and evaluated. This special issue on new technologies and research trends of embedded computing and systems for IoT and M2M provides high-quality contributions addressing related theoretical and practical aspects of associated technologies and their applications.

Semiconductors and the Internet have revolutionized and transformed our lives on how we interact with information, leading to the growth of information technology. Embedded computing devices of the same type or an extension group of devices used on the same system can be labeled as machine to machine (M2M), whereas a very large number of interconnected embedded devices in an existing Internet infrastructure is referred to as an Internet of Things (IoT). The interconnection of these embedded devices requires that they all map out the scenarios in which the things around us—from machines in manufacturing to everyday objects—exchange and evaluate data automatically and create added value for humans. Since huge amounts of data need to be stored and interpreted in the process, machine communication goes hand in hand with developments like cloud computing and big data analytics. These rapidly emerging fields will touch every aspect of life in the near future. As M2M represents a bold new generation of systems that integrate computing and communication capabilities with the dynamics of physical and engineered systems, it is yet to be seen how the IoT is going to affect economy and social structure, as a vast majority of investments are being built worldwide in developing this technology. The physical world, however, is not entirely predictable. Thus, we have a wide area of research open to explore and exploit the challenges and immense research opportunities in this IoT arena. The scope of this issue will give due consideration in all areas of research that facilitate collaboration between M2M, IoT, and existing technologies.

Each of the 24 submitted manuscripts was reviewed by at least three reviewers (guest editors and external reviewers). After two or three review cycles, 6 manuscripts were selected to be included in this special issue.

In Section 2, we briefly summarize these manuscripts. Section 3 presents a conclusion to this special issue and acknowledgement to the authors and reviewers.

“A System-Level Modeling and Design for Cyber-Physical-Social Systems,” by Jing Zeng, Laurence T. Yang, and Jianhua Ma, proposes a system-level modeling and design approach to cyber-physical-social systems (CPSS), which employs a hierarchical Petri net-based approach to model cyber, physical, and social objects in a unified representation. To model the CPSS, they present an intermediate representation model that allows the capture of function specification and achievement of system-level estimation of design performance.

In “Identifying Region-Wide Functions Using Urban Taxicab Trajectories,” Daqiang Zhang, Jiafu Wan, Zongjian He, Shengjie Zhao, Ke Fan, Sang Oh Park, and Zhibin

Jiang propose a scheme to identify hot areas using Voronoi decomposition based on the large-scale Shanghai taxicab trajectories that captured enormous traces for more than 13,000 taxicabs in approximately 3 years. The proposed scheme involves trace preprocessing, road topology construction using taxicab trajectories, extracting valid pick-up/drop-off points, and identifying region-wide functions.

“Cross-Layer Opportunistic Scheduling for Device-to-Device Video Multicast Services,” by Wen Ji, Bo-Wei Chen, Xiangdong Wang, Haiyong Luo, MuecheolKim, and Yiqiang Chen, proposes an opportunistic transmission and fair resource allocation framework, including joint application-layer and physical-layer transmission and optimization in wireless video broadcast systems. To accomplish this, they use multiuser experience measurement, channel capacity utilization improvement, opportunistic scheduling, and multicontent fair broadcasting schemes.

In “A Socio-Ecological Model for Advanced Service Discovery in Machine-to-Machine Communication Networks,” Lu Liu, Nick Antonopoulos, Minghui Zheng, Yongzhao Zhan, and Zhijun Ding present a socio-ecological model called *socio-ecological service discovery* for advanced service discovery in M2M communication networks by self-organizing autonomous nodes with socio-ecological strategies, which enable peer nodes to meet, get to know each other, and help each other.

“An Efficient Multidimensional Big Data Fusion Approach in Machine-to-Machine Communication,” by Awais Ahmad, Anand Paul, M. MazharRathore, and Hangbae Chang, proposes an efficient multidimensional big data analytical architecture based on the fusion model to enhance the computational efficiency for fusing and analyzing massive volumes of data. The main concept is that big datasets with complex magnitudes can be altered into smaller data subsets using five levels of the fusion model that can be easily processed by Hadoop processing servers, resulting in formalization of the problem of feature extraction applications using an earth observatory system, social networking, or networking applications.

In “Unified Medium Access Control Architecture for Resource-Constrained Machine-to-Machine Devices,” Eui-Jik Kim, Jung-Hyok Kwon, Ken Choi, and Taeshik Shon present the unified MAC layer architecture for resource-constrained M2M devices in capillary M2M networks named resource-constrained MAC architecture (RCMA), which has a unified framework consisting of essential functional components to support MAC-related operations of the following M2M devices: McHM, LLC, TS, and DO2S. They also implement the whole stack using the QualNet simulator to demonstrate the effectiveness of the RCMA.

Finally, our special thanks go to Professor Sandeep K. Shukla and the editorial staff for their valuable support throughout the preparation and publication of this special issue. We would like to thank the authors for their contributions to this special issue. We also extend our thanks to the external reviewers for their time and effort in reviewing the manuscripts.

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