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Editorial

Advanced Technologies and Communication Solutions for Internet of Things

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1. Introduction

Internet of Things (IoT) is one of the important issues to describe several technologies and research disciplines that enable the IoT to reach out into the real world of physical objects. IoT is also a novel paradigm that is rapidly gaining in the scenario of Wireless Sensor Networks (WSN) and Wireless Telecommunications. The basic idea of this concept is the pervasive presence around our lifestyle of a variety of things or objects [1–3]. Tremendous advances in processing, wireless sensor networks, mobile communication, and systems/middleware technologies are leading to new paradigms and platforms for computing environment. There might be many issues to realize and provide intelligent services and much effort and enormous attention have been focused on the IoT. The research area poses challenges such as the advanced technologies for sensors and actuators, identifications with objects in IoT, interoperable service-oriented technologies to share real-world data among heterogeneous devices, interoperable middleware, networking technologies for wired and wireless networking to interconnect things, application services that store, integrate, and process in real-time variable data streams from devices, infrastructure for storage and computing capabilities for IoT application services and for processing big data, quality of service assurance for efficient resource management to allocate, track, and resource utilization, scalable management of network, computing, and storage capacity across multiple objects, advanced security, privacy, authentication, trust and verification with the IoT applications, and numerical analysis and simulation technologies for IoT application with wireless sensor networks. The topics have been more aggressively covered by journals in the advanced technologies and application of the related wireless sensor networks and wireless telecommunications with the IoT [1–3]. This special issue discusses the following: advanced technologies for sensors and actuators; interoperable service-oriented technologies; interoperable middleware; networking technologies for wired and wireless networking to interconnect things; application services to store, integrate, and process real-time information; infrastructure for IoT application and services and big data processing; quality of service for efficient resource management; scalable management of network, computing, and storage capacity across multiple objects; advanced security, privacy, authentication, trust, and verification with the IoT applications; software defined networking and the opportunities in the development of IoT applications; numerical analysis and simulation technologies for IoT application with wireless sensor networks.

2. Related Works

L.-C. Tseng et al. discussed the problem of distributed channel assignment in self-organized cognitive sensor networks

with unknown channel and unknown number of clusters in the paper entitled "*Self-organized cognitive sensor networks: distributed channel assignment for pervasive sensing*." The proposed method outperforms the random selection scheme in terms of average capacity, while the performance loss compared to the exhaustive search is limited. In addition, its fairness level is comparable to that of the random selection and surpasses the exhaustive search scheme.

E. Troubleyn et al. proposed to use broadcast aggregation as a solution to overcome these drawbacks. Their paper has shown that broadcast aggregation reduces the average queue occupation with 2 (of the 15 available) places, which leads to fewer packet drops and it has been entitled "*Broadcast aggregation to improve quality of service in wireless sensor networks*." This leads on its turn to a throughput and reliability increase up to 23% compared with no aggregation and up to 15% compared with unicast aggregation. Moreover, this paper has shown that packets become less dependent on the individual timeouts per destination, which reduces the drawbacks of partial aggregation.

F. Buiati et al. presented a zone-based MIIS architecture, in which the access networks are grouped into mobility zones, managed by different MIIS servers in the paper entitled "*A zone-based media independent information service for IEEE 802.21 networks*." The decentralized MIIS deployment provides higher resilience and scalability with regard to the mobility information distribution. The results show that the proposed scheme outperforms the standard MIIS in terms of discovery delay and signaling overhead. Future work includes the study of security mechanisms and interoperator service agreement models.

Y.-S. Hong et al. implemented intelligent electronic acupuncture system using sensor modules in the paper entitled "*Implementation of intelligent electronic acupuncture system using sensor module*." This paper used the sensor modules to obtain a patient's diagnosis signals. These sensor modules consist of 5 parts. These sensor modules detect and analyze the abnormal signals from human body. The authors analyzed the signals to make instructions for the treatment. And then, the researchers designed the sensing pads for electronic acupuncture and also developed adaptive wireless acupuncture system to adjust strength and time of acupuncture and several acupuncture points of patients by using fuzzy technology.

Y. Wan et al. proposed a local search algorithm, and a theoretical approximation ratio bound has been provided in the paper entitled "*Node placement analysis for overlay networks in IoT applications*." The IoT-based overlay node placement problem is formulized and analyzed. The major contributions of the paper include providing the time complexity of multihop k-ONPP (overlay node placement problem) and its theoretical limit boundary of approximation ratio and proposing a local search algorithm. Furthermore, the time complexity and approximation ratio boundary of the local search algorithm are given. The proposed local search algorithm is evaluated by both time and efficiency where efficiency refers to the degree of approximation of algorithm results with optimal solutions. Another algorithm, TAG, is used for comparison. Finally, a simulation experiment based on network simulator EstiNet is provided. The experimental results show network delay benefits from the proposed method.

H.-I. Wang proposed the concept of the "Internet of Things" to construct a green campus environment which will realize the idea of energy saving in the paper entitled "*Constructing the green campus within the Internet of Things architecture*." The architecture of the construction of green campus is established and three application systems have been developed as well. The efforts of this work allow the campus to manage the computer labs and the air conditioners more efficiently. The sensor network will save more energy since data are reported periodically and the analysis will be carried out in time to locate the problems.

A. L. Valdivieso discussed the advantages of the innovative concept of software defined networking (SDN) in the development of Internet of Things in the paper entitled "*SDN: evolution and opportunities in the development IoT applications*." Software defined networking (SDN) appears as a viable alternative network architecture that allows programming the network and opening the possibility of creating new services and more efficient applications to cover the actual requirements. SDN proposes the separation between data and control planes and a centralized control of the network. Moreover, SDN establishes open interfaces between the control and data plane. This paper describes this new technology and analyzes its opportunities in the development of IoT applications. It also presents the first applications and projects based on this technology, such as home networking, security, virtualization, multimedia, and mobile networks, among others. Finally, the issues and challenges around the topic are discussed.

N.-C. Hsieh et al. implemented a system to deliver appropriate services according to individual needs based on its preprocessing of classification and to further reduce the costs of manpower and loading of care staff through the analysis of assessment logs in the paper entitled "*Ensuring healthcare services provision: an integrated approach of resident contexts extraction and analysis via smart objects*." With this systematic appraisal, this system can not only help care staff determine the needs of residents but also produce personalized health plans (i.e., weekly schedule towards comprehensive assessment and personalized care services). Results of implemented (and in use as well) system have demonstrated the feasibility that it can enhance the quality of care services to residents, working load of care staff, and efficiency of care-related information management for medical institution.

Y. Cui et al. proposed a system that uses UPnP to collect metadata from home appliances and cloud computing technology to store and process the metadata collected from ubiquitous sensor network environments in the paper entitled "*Home appliance management system for monitoring digitized devices using cloud computing technology in ubiquitous sensor network environment*." This system utilizes a home gateway and is designed and implemented using UPnP technology to search for and collect device features and service information. It also provides a function for transmitting the metadata from the home appliances to a cloud-based data server that uses

Hadoop-based technology to store and process the metadata collected by a home appliance monitoring service.

R. de O. Albuquerque et al. proposed and described a trust model for distributed systems based on groups of peers in the paper entitled "*GTrust: group extension for trust models in distributed systems*." A group is defined as a collection of entities with particular affinities and capabilities. All entities may have a trust and a reputation value of each other in the system. In many cases, it may be necessary to trust the whole system instead of one particular entity. In such cases, group trust represents the trust of their particular members. To achieve this, this paper presented a group trust calculation model. This paper implemented the proposed model in a P2P simulation tool and presented main results for group trust calculation.

According to J. Wang et al., a new embedded device, Webit&NEU, and its reduced embedded real-time operating system used for IoT are implemented by their China Liaoning Province Embedded Technique Key Laboratory in the paper entitled "*Webit&NEU: an embedded device for the Internet of Things*." Besides, related modules in terms of RFID technique, wireless communication, and network protocol are also provided in this paper. Compared with several current solutions of connecting devices and Internet, it has the advantages of good real-time performance, light weight, and low cost.

E. Jung et al. suggested the agent service platform named iotSilo in which agents can communicate and cooperate on behalf of the heterogeneity devices in the paper entitled "*iotSilo: the agent service platform supporting dynamic behavior assembly for resolving the heterogeneity of IoT*." With this delegation approach, the iotSilo can support diverse devices without worrying about their differences. In designing an agent, several software design patterns are adopted to enable the agent to assemble behaviors for hiding the heterogeneity of devices. To investigate the effectiveness of the iotSilo, the authors developed eleven different types of the IoT devices to emulate real-world things with Arduino, deployed the devices in both Korea and Japan, and then conducted three experiments.

X. An et al. proposed a generalized nonparametric structural estimation procedure for the first-price auctions in the distributed sensor networks in the paper entitled "*Distributed risk aversion parameter estimation for first-price auction in sensor networks*." To evaluate the performance of the aggregated parameter estimators, extensive Monte Carlo simulation experiments are conducted for ten different values of risk aversion parameters including the risk neutrality case in multiple classic scenes.

According to W. Zhang et al., to reduce these excessive idle timeslots which the 4-ary tree anticollision algorithm brings, an anticollision algorithm based on adaptive 4-ary pruning query tree (A4PQT) is proposed in the paper entitled "*An efficient adaptive anticollision algorithm based on 4-ary pruning query tree*." On the basis of the information of collision bits, some idle timeslots can be eliminated through pruning the 4-ary tree. Both theoretical analysis and simulation results support that A4PQT algorithm can significantly reduce recognition time and improve throughput of the RFID system.

M. Choi et al. designed Internet of Things architecture, especially for wireless sensor networks in the paper entitled "*Improving performance through REST Open API Grouping for wireless sensor network*." The architecture consists of wireless sensor networks with a microcontroller at the very bottom level. They are connected to smart devices at the next level. However, the computing capability of the smart devices is generally less powerful than that of the conventional devices. Thus, it is necessary to offload the computation-intensive part by careful partitioning of application functions. This research focused on designing the concept of MapReduce like approach through the web service grouping of several web services into one. Also, this paper proposed two methods: REST API grouping and REST API caching. First, the web service composition results in reducing energy consumption and communication latency by composing two or more REST web services into one. Second, the web service caching technique provides fast access that is recently accessed or frequently accessed.

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