



Advanced algorithms and applications based on IoT for the smart devices

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1 Introduction

Internet of Things (IoT) refers to the object space network that forms intelligent relationships such as sensing, networking, and information processing in a mutually cooperative manner without human intervention among distributed components such as people, objects, and services. In the IoT era, most devices are equipped with information acquisition and network connection functions, and a variety of new products and services are expected to emerge. The recent advances smart device based on IoT technologies, in particular, have been creating many challenges to computer science, real industry field, and engineering. With the introduction of realistic cases, IoT is also attracting attention in various markets.

One of the biggest challenges for IoT adoption is security and privacy issues, and the Internet connection of almost everything needs to generate, collect, distribute, manage, and utilize huge amounts of information. In the process, vulnerable security systems face two risks: public safety threats and privacy violations. Also, one of the technical challenges for introducing IoT is standards and interoperability issues. This simply means that there are still many practical problems tackled by traditional methods that are generally difficult to solve experimentally in practical smart devices for IoT environments.

For the aforementioned reasons, this special issue is soliciting advanced articles addressing research outcomes and challenges in the algorithms and applications based on IoT

for the smart devices. The general scope of this issue covers for advanced algorithms and applications based on IoT for the smart devices such as algorithms based on IoT for the smart devices, genetic programming, fuzzy set theory, neural networks, cognitive science and engineering, security and privacy, and autonomous computing and efficiency modeling in IoT for the smart devices. As a result, with careful consideration, this special issue selects and publishes excellent research articles from a large number of contributed papers.

2 Related works

Kiyeol Lee and HwaMin Lee proposed a new model that considers the bond characteristics and cracking behavior of structural reinforced concrete members to more accurately predict crack width under service load. They presented an analytical model which is mathematically derived from the actual bond stress-slip relationship between the reinforcing steel and the surrounding concrete for calculation of crack widths in structural concrete members using Internet of Things (Sato et al. 2015). The proposed crack width model is compared with the experimental data from various researchers and current design codes and it proved the improvement in mechanical consistency and accuracy.

Kyoung-Ho Jung et al. proposed a nearest user-qualified group (NUG) query that searches a group of objects. This paper presented a novel type of query called the nearest user-qualified group (NUG) query for cost effectively solving the nearest user-specified group problem (Li et al. 2016). The proposed incremental algorithm converted the NUG problem into a graph problem represented as an adjacency list. They evaluated the algorithm performance in two-dimensional space and the experimental results show that proposed algorithm outperformed the other algorithm.

Intae Ryoo et al. proposed a 3D GM MAC scheme to maximize energy efficiency for IoT ecosystem environments. The proposed scheme was designed to set up node

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group numbers based on distances (hop) from a sink node to mobile sensor devices located in a three-dimensional space (Buddha and Daya 2012). From experimental simulation results, they verified the excellent behavior in the aspect of energy efficiency for the target IoT ecosystem.

J. Javier Rainer et al. proposed a novel method to generate automatic presentations using fuzzy logic in combination with the opinion of people as a feedback to guide tours in museums. A decision-making algorithm based on fuzzy rules, logic control strategy, and human evaluations have been implanted in order for the robot to recalculate the quality of the presentation depending on the feedback that different levels of cultures and age can provide (Margaliot and Langholz 1999).

Gangman Yi et al. proposed mobile resource management (MRM) without Cloud Server, which is the computing resource integrated management of mobile devices. It is able to establish mobile computing infrastructure without a cloud server and to provide computing services (Motavaselahagh et al. 2015). In order to measure the MRM availability during integration of the MRM resources and validate the service effectiveness, they evaluated the time required for resource integration and task assignments for computing service requests. Experiment results showed that proposed methods provided high availability, which guaranteed the sustainable use of mobile computing services.

SELFNET H2020 Project provides a smart autonomic network management framework for 5G mobile networks (Xu et al. 2016). Lorena Isabel Barona López et al. surveyed the key elements of the SELFNET Analyzer Orchestrator, including the initial assumptions, design principles, workflows, sets of actions, execution strategies, and several examples of their application. The proposed orchestration strategy in this paper has been implemented with different user cases within the SELFNET Project.

Amin Azmoodeh et al. presented machine learning techniques to detect ransomware attacks based on their power usage patterns on android devices. In order to classify ransomware from non-malicious applications, the proposed method monitors the energy consumption patterns of different processes using the unique local fingerprint of ransomware's energy consumption (Song et al. 2016). The proposed method provides improved accuracy rate, recall rate, precision rate, and F-measure compared with K-Nearest Neighbors, Neural Networks, Support Vector Machine, and Random Forest.

Recently, as device technology has been developed rapidly, it has been expanded to serve as an endpoint that generates various kinds of information. This is an improvement in comparison with device technologies in the past, which provided only simple information by controlling a terminal through a network. Eunhye Ko et al. suggested a platform structure and application method for collecting, analyzing,

and sharing vulnerability information about IoT devices to prevent cyber-attacks using the information of vulnerable devices connected to the Internet (Huh and Seo 2016). The proposed technology in this paper provides public vulnerability information and patch information to respond quickly through checking vulnerability of devices. Through the experimental results of the proposed technique, the proposed platform is expected to effectively prevent security threats and accidents when it shares the threat information with network service providers. SuHyun Kim and ImYeong Lee proposed a method, a proxy re-encryption, which enables data sharing and management using existing encryption algorithms, in an environment consisting of multiple lightweight devices. The proposed method provides a data sharing function to supplement the insufficient capacity of lightweight device networks and enhanced security features by using elliptic curve cryptosystem-based proxy re-encryption schemes in lightweight devices (Keegan et al. 2016).

Fei Hao et al. proposed a soft set-based recommendation model and devised the corresponding algorithm to recommend the suitable mobile cloud services to users. The proposed recommendation model considers the multiple constraints for the recommendation of mobile cloud services; thus, the problem of mobile cloud services recommendation converted into a multiple-criteria decision-making (MCDM) process (Cho and Song 2015). Through case studies, the experiments proved the feasibility and effectiveness of the proposed recommendation model.

Noo-ri Kim et al. implemented a detection model based on a deep neural network to identify the relations between two given documents. The proposed detection model provides document relation modeling and a detection process to detect document changes (Rafiei and Kardan 2015). The experimental results showed that the proposed model outperformed others composed of PV, SM, and CNN.

Masoom Alam et al. proposed a novel garbled model to provide fine-grained security with following features: oblivious roles assignment, garbled dynamic separation of duty, and partial rule (Wang et al. 2016). The proposed model provides the flexible authentication based on the user's context information and efficient security to the cloud access controls. This study proposed a general and modular framework to develop a methodology and architecture for the implementation of Ambient Intelligence (AmI) middleware.

Svetlana Kim and Yong-Ik Yoon proposed a context awareness framework called awareness-cognition (AC) for ambient intelligence to solve problems with predictions by discovering personalized knowledge through combining multiple contexts (Ogie 2016). The study developed a middleware layer of an AmI system which can handle context-aware analyses and exhibits high accuracy and efficiency. The proposed AmI middleware provides the scalability with high processing capabilities to combine multiple contexts.

Simon Fong et al. proposed an improved version of very fast decision tree (VFDT) which learns from misclassified results in order to filter the noisy data and maintain classification accuracy of the induced prediction model. The proposed method used a new technique called misclassified recall (MR), which is a pre-processing step for self-rectifying misclassified instances. Simulation experiment results showed that the improved efficacy of the new methodology VFDT + MR, in comparison with a collection of popular data stream mining algorithms from the literature (Anuradha and Vidushi 2015).

Shu-Ching Wang et al. proposed a middleware layer framework which can filter and integrate the vast amounts of information to get the meaningful and available information. In order to improve the effectiveness of the system, three-phase scheduling (3PS) under a cloud computational resource layer is proposed (Molano et al. 2017). The experiment results showed that the proposed method obtained the better load balance in each cluster, and the utilization rate of the nodes of each cluster was 100%.

Sunmin Lee and Nammee Moon proposed a location recognition system for users based on WiFi data (BSSID, RSSI) using Random Forest. In order to improve the accuracy, a radio Map was made to store BSSID efficiently and the filtered values were used as the learning data of Random Forest (Malhotra and Jangra 2017). Experiment results showed that the proposed algorithm had better accuracy, averaging 6.04% higher than the RSSI-based Random Forest location recognition.

References

- Anuradha P, Vidushi S (2015) A review on stochastic approach for dynamic power management in wireless sensor networks. *Hum Cent Comput Inf Sci* 5(4):1–14. <https://doi.org/10.1186/s13673-015-0021-6>
- Buddha S, Daya KL (2012) A novel energy-aware cluster head selection based on particle swarm optimization for wireless sensor networks. *Hum Cent Comput Inf Sci* 2:13. <https://doi.org/10.1186/2192-1962-2-13>
- Cho YS, Song CM (2015) Recommender system using periodicity analysis via mining sequential patterns with time-series and fractal analysis. *J Converg* 6:9–17
- Huh JH, Seo K (2016) Design and test bed experiments of server operation system using virtualization technology. *Hum Cent Comput Inf Sci*. <https://doi.org/10.1186/s13673-016-0060-7>
- Keegan N, Ji SY et al (2016) A survey of cloud-based network intrusion detection analysis. *Hum Cent Comput Inf Sci* 6:19. <https://doi.org/10.1186/s13673-016-0076-z>
- Li Y, Kim D, Shin BS (2016) Geohashed spatial index method for a location-aware WBAN data monitoring system based on NoSQL. *J Inf Process Syst* 12(2):263–274. <https://doi.org/10.3745/JIPS.04.0025>
- Malhotra R, Jangra R (2017) Prediction and assessment of change prone classes using statistical and machine learning techniques. *J Inf Process Syst* 13(4):778–804. <https://doi.org/10.3745/JIPS.04.0013>
- Margaliot M, Langholz G (1999) Fuzzy Lyapunov based approach to the design of fuzzy controllers. *Fuzzy Sets Syst* 106(1):49–59. [https://doi.org/10.1016/S0165-0114\(98\)00356-X](https://doi.org/10.1016/S0165-0114(98)00356-X)
- Molano JIR et al (2017) Metamodel for integration of Internet of Things, social networks, the Cloud and Industry 4.0. *J Ambient Intell Hum Comput*. <https://doi.org/10.1007/s12652-017-0469-5>
- Motavaselalghagh F et al (2015) Knowledge-based adaptable scheduler for SaaS providers in cloud computing. *Hum Cent Comput Inf Sci* 5(14):1–19. <https://doi.org/10.1186/s13673-015-0031-4>
- Ogie R (2016) Adopting incentive mechanisms for large-scale participation in mobile crowdsensing: from literature review to a conceptual framework. *Hum Cent Comput Inf Sci* 6:24. <https://doi.org/10.1186/s13673-016-0080-3>
- Rafiei M, Kardan AA (2015) A novel method for expert finding in online communities based on concept map and PageRank. *Hum Cent Comput Inf Sci*. <https://doi.org/10.1186/s13673-015-0030-5>
- Sato A et al (2015) Design of fusion technique-based mining engine for smart business. *Hum Cent Comput Inf Sci* 5:1–16. <https://doi.org/10.1186/s13673-015-0036-z>
- Song S et al (2016) The effective ransomware prevention technique using process monitoring on android platform. *Mobile Inf Syst* 2016:3–11
- Wang Y et al (2016) Garbled computation in cloud. *Future Generation Computer Systems* 62:54–65. <https://doi.org/10.1016/j.future.2015.11.004>
- Xu L et al (2016) CogNet: a network management architecture featuring cognitive capabilities. In: *Proceedings of the European conference on networks and communications*, Athens, Greece, pp 325–329