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Guest Editorial: Special Section on Distributed Intelligence over Internet of Things

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Guest Editorial: Special Section on Distributed Intelligence Over Internet of Things

NOWADAYS, billions of devices are connected to the Internet, enabling Internet of Things (IoT) systems widely deployed, such as smart city, smart healthcare, and intelligent plant, to capture a great quantity of sensing data. Consequently, the data transmission, processing, and analysis in IoT applications bring a great pressure to the central server. Fortunately, distributed intelligence becomes one of the potential solutions. Distributed intelligence can greatly relieve server pressures via plenty of terminal devices, and these devices collaboratively perceive and handle the mass data to improve the reliability, scalability, and security of industrial IoT systems. As future IoT system will embrace more wireless sensors and devices, the high-performance computing, high-bandwidth and low-latency communication are excessively required, many new research opportunities and challenges for distributed intelligence over IoT have arisen.

To promote the development of distributed intelligence technology, this special section (SS) focuses on various technologies and platforms regarding industrial IoT systems. This SS received nearly 50 submitted manuscripts, out of which ten of them have been accepted after a rigorous peer review. Each manuscript is reviewed by multiple rounds of review with at least three or four reviewers, the problems to be solved, and the innovation of each manuscript are mainly concerned. Then, the accepted articles are summarized as follows in details.

Considering the joint optimization of the offloading decision and resource allocation under limited resource constraints in collaborative edge computing networks with multiple IIoT devices and MEC servers, an improved differential evolution algorithm [A7] is proposed to minimize the weighted sum of cost of energy consumption and time delay, which can effectively reduce the system delay and energy consumption. In order to improve the performance of task scheduling in cloud computing, Attiya *et al.* [A1] proposed a novel hybrid swarm intelligence method MRFOSSA, which uses a modified Manta-ray foraging optimizer (MRFO) and the Salp swarm algorithm (SSA). MRFOSSA is superior to other methods in terms of makespan time and cloud throughput. The research goal of the article [A5] is to design an intelligent computing offloading strategy for industrial applications in order to optimize costs and mitigate energy losses. Then, the paper proposes to combine a fog controller and AI-based learning techniques so that the fog controller can intelligently assign tasks to the most appropriate fog devices and find the appropriate path to the target. Considering the resource utilization efficiency under dynamic overload requests and network states in IIoT, Chen *et al.* [A2] proposed a DRL-based intelligent service function chain (SFC) orchestration scheme and jointly optimize the virtualized network function (VNF) deployment and SFC embedment by the improved double deep Q network (DDQN) algorithm, which can improve the performance of resource utilization rate, execution cost, and delay compared with other representative schemes.

To solve the problem of resource allocation and energy cost in Internet of Vehicles, Kong *et al.* [A8] designed a joint computing and caching framework and formulate the problem as a reinforcement learning problem to minimize the energy cost. On this basis, the optimization algorithm based on deep deterministic policy gradient (DDPG) is proposed, which can effectively decrease energy costs. To reduce the query numbers of the object model when constructing adversarial examples, Zhang *et al.* [A10] proposed generating adversarial examples with shadow model, i.e., transferring the query operations to the designed shadow model, which can achieve high attack success rates. Chen *et al.* [A3] revised a decentralized-wireless-federated-learning algorithm that utilizes the superposition property of the analog scheme. It can solve the problem of single failure, limited bandwidth resource, and privacy protection in the wireless federated learning algorithm, which can be applied widely in wireless IoT networks. To reduce the resource consumption in CNN-based applications, Jia *et al.* [A6] proposed the CNN-based resource optimization approach that utilizes model compression and computation sharing to optimize inner model and intermodel, respectively, and the comparison results show the superior performance in scalability and the decrease of resource cost.

In mobile crowdsensing activities, Gao *et al.* [A4] proposed a differential location privacy-preserving mechanism based on trajectory obfuscation to protect the location privacy of mobile users, which includes three operations: stay points extraction, stay points obfuscation, and stay points sampling. In order to mimic the task-free bottom-up visual attention process by predicting salient regions on natural images, Umer *et al.* [A9] proposed a pseudo knowledge distillation model based on knowledge distillation and pseudolabeling technique, which is computationally efficient and suitable for real-time on-device saliency prediction.

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APPENDIX
RELATED ARTICLES

[A1] I. Attiya, M. A. Elaziz, L. Abualigah, T. N. Nguyen, and A. A. A. El-Latif, "An improved hybrid swarm intelligence for scheduling IoT application tasks in the cloud," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3148288.

[A2] H. Chen, S. Wang, G. Li, L. Nie, X. Wang, and Z. Ning, "Distributed orchestration of service function chains for edge intelligence in the industrial Internet of Things," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3131757.

[A3] S. Chen, D. Yu, Y. Zou, J. Yu, and X. Cheng, "Decentralized wireless federated learning with differential privacy," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3145010.

[A4] Z. Gao, Y. Huang, L. Zheng, H. Lu, B. Wu, and J. Zhang, "Protecting location privacy of users based on trajectory obfuscation in mobile crowdsensing," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3146281.

[A5] A. Hazra and T. Amgoth, "CeCO: Cost-efficient computation offloading of IoT applications in green industrial fog networks," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3130255.

[A6] Y. Jia *et al.*, "CroApp: A CNN-based resource optimization approach in edge computing environment," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3154473.

[A7] Z. Jin, C. Zhang, Y. Jin, L. Zhang, and J. Su, "A resource allocation scheme for joint optimizing energy-consumption and delay in collaborative edge computing-based industrial IoT," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3125376.

[A8] X. Kong, G. Duan, M. Hou, G. Shen, H. Wang, and M. C. X. Yan, "Deep reinforcement learning based energy efficient edge computing for internet of vehicles," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3155162.

[A9] A. Umer, C. Termritthikun, T. Qiu, P. H. W. Leong, and I. Lee, "On-device saliency prediction based on pseudo knowledge distillation," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3153365.

[A10] R. Zhang, H. Xia, C. Hu, C. Zhang, C. Liu, and F. Xiao, "Generating adversarial examples with shadow model," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3139902.

Honglong Chen (Senior Member, IEEE) received the B.E. degree in automation from the China University of Petroleum, Beijing, China, in 2006, the M.E. degree in control science and engineering from Zhejiang University, Hangzhou, China, in 2008, and the Ph.D. degree in computer science from The Hong Kong Polytechnic University, Hong Kong, in 2012.

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