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Editorial: Cognitive Industrial Internet of Things

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1 Editorial

Following the great success of 2G and 3G mobile networks and the fast growth of 4G, the next generation mobile networks or 5th generation wireless systems (in short 5G) was proposed aiming to provide infinite networking capability to mobile users. Different from 4G, 5G is much more than increased maximum throughput. It aim to involve and benefit from many current technical advances including massive dense networks, interference and mobility management, Internet of Things (IoT), pervasive and social computing, mobile ad hoc networks (MANET), cognitive radio, World Wide Wireless Web (WWWW), cloud computing, IPv6, and so on. How 5G should and will be, what will be the keys for 5G? What is the perspective of 5G architecture and technologies? How to effectively apply and benefit from the above technologies and make them intelligently interoperate together? How can 5G stimulate our innovation for the next generation of mobile networks and services? Obviously, integrating all above existing advanced technologies and innovating new techniques for 5G bring extreme challenges on 5G networks and services in both research and development. This study has just initiated in both industry and academia, but with great fervor all over the world.

Cognitive Industrial Internet of Things (Cognitive-IIoT) is the use of cognitive computing technologies, which is derived from cognitive science and artificial intelligence, to power next generation Industrial IoT. With the growth and adoption of IoT, factories are becoming more instrumented and interconnected. Cognitive-IIoT provides high performance of communicating, computing, controlling, and even high degree of machine intelligence for emerging smart industrial IoT applications, such as cognitive manufacturing and Industry 4.0. Cognitive-IIoT redefines the relationship between human, machine and their pervasive digital environments. They may play the role of assistant or coach for the manufacturers, and industrial technologists. Specifically, the Industrial IoT generated industrial big data, when used to power predictive analytics algorithms or to develop a corps for a cognitive computing solution, can provide insights that would never be discovered in time to be useful if the departmental silos do not collaboration in data sensing and analysis. It is the integration of this data that enables cognitive computing applications for Industrial IoT of the next decade. Therefore, the services of a Cognitive-IIoT could be constructive, prescriptive, or instructive in nature. This special issue aims to explore recent advances and disseminate state-of-the-art research related to Cognitive-IIoT on designing, building, and deploying novel cognitive computing, services and technologies, to enable smart industrial IoT services and applications.

This special issue features six selected papers with high quality. The first article, "CrossRec: Cross-domain Recommendations based on Social Big Data and Cognitive Computing", authored by Yin Zhang et al., considered the advantages of social-based and cross-domain approaches involving further additional data. They proposed a cross-domain recommender system, including three approaches, based on multi-source social big data. The proposed approach is available to to effectively alleviate the issues of cold-start users by transferring user preferences from a related auxiliary domain to a target domain. Moreover, the sufficient experiments show that the proposed system is significantly improved compared with the conventional recommender approaches, such as collaborative filtering and matrix factorization.

The advancements in cognitive computing and its the integration with IoT and cloud technologies has given rise to new human-centered computing with cognitive intelligence on cloud. In the second article titled "Cognitive IoT-Cloud Integration for Smart Healthcare: Case Study for Epileptic Seizure Detection and Monitoring", the authors proposed cognitive framework for smart healthcare which is applied to a case study of real-time monitoring and detection of epileptic

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seizures. Smart sensors are employed which are either worn by patients or embedded in the smart city environment. They record scalp EEG, psychological and physiological signals and send them to the LAN layer which transmits them to the hosting layer. The smart devices in the hosting layer finally transmit these signals to the cloud via the 4G/5G medium. These variety of signals including patients' movements, gestures, and facial expressions are combined with the EEG and sent to the deep learning module to determine patient's state and presence of seizures. The intelligent framework keeps track of the patient and decides the future course of activities by involving different stakeholders of the smart city. Cognitive engine uses hybrid deep learning and attains high accuracy and senstivity. The results of seizure detection are transmitted at real-time to the healthcare professionals, who can provide timely assistance in critical cases.

In the third article with the title "Q-Learning-Based Dynamic Spectrum Access in Cognitive Industrial Internet of Things", the authors proposed a dynamic spectrum access method for Industrial Internet of Things (IIoT) by introducing cognitive self-learning technique to solve the problem of distributed self-accessing of unlicensed sensor terminals. According to the distributed network framework and senors' non-perfect sensing ability, sensor terminals update the channels' Q values through self-learning.A MAC access protocol is devised to enhance spectrum efficiency and decrease transmission conflict probability in the dynamic spectrum access-based IIoT.

In the next paper with the title "Telesurgery Robot Based on 5G Tactile Internet", the authors introduced a telesurgery robot based on the 5G tactile Internet and artificial intelligence technology. The architecture, composition, characteristics, and advantages of telesurgery are explained in detail from two aspects, the intelligent tactile feedback, and human-machine interaction data. On this basis, a human-machine interaction optimization scheme during the telesurgery process is presented from three aspects, i.e., Edge-Cloud integration, network slice, and intelligent Edge-Cloud. Finally, this paper discusses the open issues of the presented telesurgery system regarding the ultra-high reliability, AI-enabled surgery robot, communication, and security, to provide the reference for the promotion of the telesurgery robot performance.

The ureter injury occasionally happens in the gynecology, abdominal and urinary surgeries. The medical negligence may cause severe problems for the hospital, and mental pressure for the doctors. The fifth article titled "An Image-guided Endoscope System for the Ureter Detection" proposes an image-guided endoscope system for the ureter detection. The authors use the image acquirement, aided detection, image segmentation, and fusion to achieve the goal. We proposed a novel image-guided endoscope system for the ureter detection, and the ureter position can be displayed during the surgery. The proposed system may reduce the ureter injury in surgery, and improve the surgical success rate.

The last article titled "Extraction of GGO Candidate Regions on Thoracic CT Images Using SuperVoxel-based Graph Cuts for Healthcare Systems" proposes a method to reduce artifacts on temporal difference images by improving the conventional method using a non-rigid registration method for ground glass opacification (GGO), which is light in concentration and difficult to detect early. In this method, global matching, local matching, and 3D elastic matching are performed on the current image and past image, and an initial temporal difference image is generated. After that, they use an Iris filter, which is the gradient vector concentration degree filter, to determine the initial GGO candidate regions and perform segmentation using SuperVoxel and Graph Cuts in which a superpixel is extended to three dimensions for each region of interest. For each extracted region, a support vector machine (SVM) is used to reduce the oversegmentation. Finally, in the method that greatly reduces artifacts other than the remaining GGO candidate regions, Voxel Matching is applied to generate the final temporal difference image, emphasizing the GGO regions while reducing the artifact. The resulting ratio of artifacts to lung volume is 0.101 with an FWHM of 28.3, which is an improvement over the conventional method and shows the proposed method's effectiveness.

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