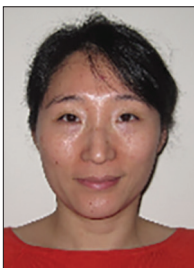# ADVANCES IN NEXT-GENERATION NETWORKING TECHNOLOGIES FOR SMART HEALTHCARE

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With the advancement of next-generation mobile and wireless networking technologies, "smart healthcare" or "connected healthcare" is getting tremendous attention from academia, governments, industry, and the healthcare community. The next-generation mobile and wireless networking technologies such as 5G wireless networks, mobile edge computing (MEC), software-defined networking (SDN), and cloud radio access networks (C-RANs) can play a significant role in smart healthcare by offering better insight of heterogeneous healthcare media content to support affordable and high-quality patient care. While researchers have been making advances in the study of next-generation networking and healthcare services individually, very little attention has been given to make cost-effective and affordable smart healthcare solutions. Connected or smart healthcare has the potential to revolutionize many aspects of our society.

While researchers have been making advances in the study of smart healthcare, many issues still remain to be addressed with regard to the impact of networking technologies for smart healthcare. It is envisioned that the next-generation networking technologies will be the success factor for realizing the true vision of smart healthcare since they will contribute to facilitating resource-constrained devices to communicate efficiently, faster data generation and processing, as well as high-quality data transmission to stakeholders. This Feature Topic (FT) collates articles from a wide range of perspectives that stem from different industrial and research communities for the advancement of next-generation networking technologies for smart healthcare. Following a rigorous review process, from a good number of submissions, only a few articles have been selected for publication in this April 2018 issue of *IEEE Communications Magazine*. The first article, "5G-Smart Diabetes: Toward Personalized Diabetes Diagnosis with Healthcare Big Data Clouds," written by M. Chen *et al.*, investigates a novel solution for the diagnosis and treatment of diabetes. The "5G" in 5G-Smart Diabetes has a twofold meaning. On one hand, it refers to the fifth generation (5G) technology that will be adopted as the communication infrastructure to provide treatment services and continuous monitoring of the physiological states of patients with diabetes. On the other hand, 5G refers to

the following "five goals": cost effectiveness, comfortability, personalization, sustainability, and smartness. The authors discuss the data sharing mechanism and design the data analysis model for the disease with the support of the 5G-Smart Diabetes solution.

Secure transmission and storing the remote healthcare data in the smart city environment is an important aspect to consider. In this respect, the article "LSCSH: Lattice-Based Secure Cryptosystem for Smart Healthcare in Smart Cities Environment" proposes a lattice-based authentication mechanism to transmit the shared secret key to validate user authentication. Moreover, the encryption and decryption process is also based on lattice operations, which are performed using a lightweight secret key so as to put a minimum additional burden on the network. Apart from these, the authors also propose an access rights verification mechanism based on tag matching so that the patient(s) can view only their information while the doctors can access the information of only those patients who are associated with them. The article "Medical Image Forgery Detection for Smart Healthcare" presents a medical image forgery detection system for a cloud-based healthcare framework. Forgery in the medical image can lead to a wrong diagnosis, and patients may face social embarrassment. The presented system is a non-invasive system, where features are extracted from the noise pattern of the image and classified using a fusion of two classifiers, which are a support vector machine and an extreme learning machine. The system could successfully detect forgeries in medical images.

With the growing emergence of wearable biosensors and wireless communication technologies, Internet of Thing (IoT) devices in smart healthcare are vulnerable to privacy breaches and safety threats. Security and privacy protection are certainly very important issues of healthcare IoT applications, as IoT devices lack capabilities to protect other connected devices from attack. To this end, the article "Privacy in the Internet of Things for Smart Healthcare" presents security vulnerability issues related to password strength in order to have a higher degree of security in smart healthcare.

The article "Large-Scale Mobile Fitness App Usage Analysis for Smart Health" investigates mobile fitness app usage data from more than 14,000 cellular towers and

4000 users. This work finds key factors of temporal, location, mobility, and personal incomes that influence this app usage. These findings are important for developing public policy and planning cities. The article "Indoor Anti-Collision Alarm System Based on the Wearable Internet of Things for Smart Healthcare" presents a smart system to help visually impaired people away from obstacles. A locally weighted linear regression algorithm is used for RSSI fingerprint extraction to identify the distance between the RFID tag and antenna, while unwrapped phases are used for indicating the degree at which a user is straying off the normal path. This article is a true manifestation of technology being applied to people's daily lives and brings more solutions to smart healthcare.

The article "Edge Computing with Cloud for Voice Disorders Assessment and Treatment" presents an edge computing framework where deep-learned features of voice signals are used to assess the condition of a voice. Based on the assessment, some treatment or therapy is prescribed. The processing, assessment, and treatment are managed by an application management system in the cloud, an edge computing (EC) application platform management system, and an EC hosting infrastructure management system. The proposed system within a healthcare framework can contribute toward a solution of vocal-fold-related diseases.

In closing, the Guest Editors would like to thank all the authors, who significantly contributed to this FT, and the reviewers for their efforts in respecting deadlines and their constructive reviews for this FT. We are also grateful to the Editor-in-Chief, Tarek El-Bawab, for his support and the *IEEE Communications Magazine* publication staff as well, who collaborated with us in every step. We hope that researchers and practitioners in this field will find the articles of this FT constructive and interesting. We hope this FT will inspire further research and development ideas for the next-generation network technologies on smart healthcare.

BIOGRAPHIES

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