Special Issue on Sensing and Information and Communication Technologies toward Non-intrusive, Undisturbed, and Calm Healthcare Monitoring

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Preface

I am pleased to introduce this special issue on advanced technology of physiological sensing, information and telecommunication, and biological information analysis to achieve less-burden healthcare support.

The importance of less-cumbersome physiological measurement technology is well recognized in the fields of medical and nursing care, home healthcare, and conditioning in sports. Ambulatory (using mobile, wearable, and implant devices), nonconscious (all the necessary sensors are built into existing home facilities), and other types of less-burdensome measurement systems together with the progress in information and communication technologies have made it possible to analyze enormous quantities of data in daily practical use.

From these viewpoints, the first three papers show new monitoring techniques to develop portable, wearable, and ambient systems. In the first paper, a new sensing and analytical method for sodium and potassium using multi-wavelength NIR spectroscopy is reported. With this method, sweat components can be obtained by the photosensor with only two wavelengths, showing its usefulness for developing portable devices for evaluating exercise intensity, fatigue, and stress especially in the sports field. In the second paper, it is shown that a small inertial sensor attached to the subject's chest can be available for monitoring respiration; thus, new wearable devices will be applied to the early diagnosis of cardiopulmonary diseases by the assessment of respiratory fluctuations. The third paper shows a bathtub-pasted electrocardiogram monitor without the attachment of any sensors to the subject, which will be useful for detecting abnormal rhythms of heartbeats, early treatment of heart failure, and the prevention of drowning during bathing.

Moreover, not only vital signal monitoring techniques but also information and telecommunications networks are also required for the undisturbed operation of sensor systems. The fourth paper describes the development of a downsized wireless communication with a high-frequency band using an on-chip antenna, which will be helpful for data transfer between inside and outside the body and power transfer to an implanted small sensor chip.

On the other hand, the investigation of sensor device applications and data analysis methods must be noted. In particular, continuous personal health recording (PHR) can be a useful means for the early detection of signs and risk factors associated with various disorders and the effectiveness evaluation of treatment, therapy, and training to improve and maintain health conditions and physical activity. Therefore, the knowledge obtained in the last two papers can be recommended for the practical use of conventional and innovative sensor devices. For example, the fifth paper describes the prediction method for acute decompensated heart failure using

deep learning for the vital signs and other types of medical information during hospitalization. The results described in this paper can be applied to more effective medical care of patients not only during hospitalization but also after leaving the hospital. Moreover, in the sixth paper, the attempt to assess the effectiveness of essential oil for sleep using wearable devices is shown, with one of the applications demonstrated by fusing the advanced device and data analysis for daily healthcare.

Recently, a new concept called “calm healthcare technology” has been proposed, which uses physiological monitoring that fits in very well with daily life activities. To practically realize such a concept, further investigations of sensing and information and communication technologies will be required increasingly; thus, this special issue can help researchers reach this goal.

Finally, I would like to extend my gratitude to all the participating reviewers and the staff members of Sensors and Materials. I would especially like to thank Ms. Tomoko Tanabe of MYU K.K. for her commitment to this special issue.

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