Guest Editorial
Sensing Psychological Parameters and AI-Enabled Emotion Care for Human Wellness

AS THE coronavirus pandemic deepens, lots of people lose their jobs and the normal pace of life, resulting in lots of negative emotions, such as nervousness, anxiety, sleeplessness and depression. There is an urgent demand to pay more attention to psychological health for human wellness by providing methods and means of sensing psychological parameters, emotional care and mental disorder patient monitoring, especially during these difficult times. With the aid of wearable computing technology and artificial intelligence, emotion and mental disorder detections are available through sensing and analyzing psychological parameters [1].

Considering as "small things" the above wearable devices which can provide and process health related information, and following the IEEE Internet Initiative definition for Internet of Things [2], Internet of Small Things in Healthcare can be defined as *a network that connects uniquely identifiable "Small Things" to the Internet. The "Small Things" have sensing/actuation and potential programmability capabilities. Through the exploitation of unique identification and sensing, information about the "Small Thing" can be collected and the state of the 'Thing' can be changed from anywhere, anytime, by anything contributing to a personalized digital emotion care for the patient.*

Wearable sensors can collect multimodal data, such as physiological data of the human body and psychological data closely related to emotion, including ECG, EEG, blood pressure, blood oxygen, etc. Combining with conventional data, such as video, audio and speech text data, significant mental health characteristics can be obtained using deep learning technology. Though sensing psychological parameters and AI-enabled emotion care are expected to play a major role in improving human wellness, it faces a lot of challenges, such as psychological data processing and analysis, AI-based emotion monitoring and care, etc.

In such evolving digital healthcare, the amount of data is continuously increasing and the traditional solutions of data acquisition, storage, management, analysis and visualization cannot be applied. These large amounts of data, the Big Data, require non-traditional scalable solutions. It's unquestionable that sensing psychological parameters and AI-enabled emotion care based on Big Data are expected to play a major role in improving human wellness [5]. However, personalizing and digitalizing care still face many challenges when it comes to consideration and real exploitation of Big Data.

Big Data (the structured and the semi-structured or non-structured datasets) are creating big challenges on multimodal data processing and analysis. Healthcare Big Data are gathered from different sources and, when combined, they are of low quality and full of noise. Use of different standards across various systems and organizations contributes to the quality of existing healthcare data, which needs to be improved, while organizational support for technological innovations and quality management is sought [6].

Moreover, there is a need for algorithms and tools to sense psychological parameters [7] including scalable computational architectures for machine learning, multimodal data processing and analysis, statistical methodologies, predictive analytics, classification algorithms and techniques and other. Considering data gathered from different sources of low quality and full of noise [8], building a paradigm of health informatics for human wellness and patient monitoring should also be taken into consideration [5].

As wearable technique and intelligent robotics has achieved rapid development [8], additional research is needed on sensing psychological parameters and emotion care through wearable computing and robotics to extract meaningful information to foster the personalization of Medical Information Systems.

Due to increasing researches on top of existing biomedical and health informatics, there is a need for harmonizing advanced hardware and software for patient monitoring, as well as emotion care applications, services, and systems based on health informatics.

Moreover, case studies on AI-aided emotion care and mental disorder patient monitoring can contribute to providing knowledge and research direction of latest scholars. Well-studied and persuasive case studies help professionals and public to fully accept of such changes and advancements in biomedical and health informatics [10].

With all this in mind, this special issue is meant to provide just a snapshot of some of the latest research advances on the research and application of Small Things and Big Data, knowledge discovery and knowledge representation for the combination towards biomedical and health informatics.

The first paper by Abramov et al. [A1] addresses report on the impact of emotions on human performance. Gaming and eSports tournaments require strong mental abilities to avoid severe stress and other negative consequences upon completing the game. In this paper, audio recordings and game logs are collected from the players in real conditions at an eSports tournament, which is

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further used in trained machine learning models for analysis of players' emotional conditions from the voice during the game. The recognition models of several types of emotions as well as the background sounds are applied to measure the eSports team's performance from the players' emotional conditions.

The second paper by Miao et al. [A2] addresses that people's emotions can be perceived, understood, expressed and responded by affective brain computer interface (ABCI). While electroencephalography (EEG) signals are most frequently adopted as the physiology measurement in ABCI applications, eye blinking and movements introduce lots of artifacts into raw EEG data, which seriously affect the quality of EEG signal and the subsequent emotional EEG feature engineering and recognition. For this reason, this paper proposes a fully automatic and unsupervised ocular artifact identification and removal algorithm named automated canonical correlation analysis (CCA)-multi-channel wiener filter (MWF) (ACCAMWF).

The third paper by Hao et al. [A3] considers necessary to monitor the behavior of human with mental disorders under surveillance video, refraining from the abnormal violent behavior by such people. However, it is a comprehensive challenge to detect abnormal behavior of human (especially patients with mental disorders) based on abnormal detection and motion recognition technology. To address these issues, it proposes an end-to-end abnormal detection framework from a new perspective in conjunction with the Graph Convolutional Network (GCN) and a 3D Convolutional Neural Network (CNN). In order to better detect the violent behavior of patients with mental disorders, the paper focuses on the UCF-Crime dataset of violent behavior.

The forth paper by Yu et al. [A4] focuses on EEG signals classification, by developing a computer-aided broad learning EEG system (CABLES) for the classification of six distinct EEG domains under a unified sequential framework. Three novel modules namely, complex variational mode decomposition (CVMD), ensemble optimization-based features selection (EOFS), and t-distributed stochastic neighbour embedding based samples reduction (tSNE-SR) methods respectively for the realization of CABLES. The proposed CABLES framework in this paper outperforms the existing domain-specific methods in terms of classification accuracies and multirole adaptability, thus can be endorsed as an effective automated neural rehabilitation system.

The fifth paper by Teh et al. [A5] aims to determine the predictive accuracy of digital biomarker technologies to detect mild cognitive impairment and pre-frailty with systematic review and meta-analysis. Computer-assisted search on major academic research databases including IEEE-Xplore was conducted. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines were adopted reporting in this study. Summary receiver operating characteristic curve based on random-effect bivariate model was used to evaluate overall sensitivity and specificity for detection of the respective age-related conditions.

The last paper by Chen et al. [A6] considers to use biophysiological signals to detect Mind-wandering (MW). The first contribution is to collect a database for multi-modal Sustained Attention to Response Task (MM-SART), including 32-channel electroencephalogram (EEG) signals, photoplethysmography (PPG) signals, galvanic skin response (GSR) signals, eye tracker signals, and several questionnaires for MW detection. Then, the authors propose an effective MW detection system based on the collected EEG signals. To further explore the non-linear characteristics of the EEG signals, the authors utilize entropy-based features with the proposed feature selection framework called correlation importance feature elimination (CIFE). The experimental results show that the new method can reach 0.725 Area Under Curve (AUC) score by using the random forest (RF) classifier with the leave-one-subject-out cross-validation.

All six papers tackle different but extremely relevant domain vectors of the Internet of Small Things and Big Data in Health. We believe this Special Issue will raise awareness in the scientific community, through presenting and highlighting the advances and latest novel and emergent technologies, implementations, applications concerning the sensing psychological parameters, emotion care and mental disorder patient monitoring. In closing, we would like to thank all the authors who submitted their research work to this special issue. We would also like to acknowledge the contribution of many experts in the field who have participated in the review process, and provided helpful suggestions to the authors to improve the contents and presentations of the articles. We would in particular like to thank Professor Dimitrios I. Fotiadis, the Editor-in-Chief, and the publishing team for their support and very helpful suggestions and comments during the delicate stages of concluding the special issue.

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Appendix
Related Articles

[A1] S. Abramov, A. Korotin, A. Somov, E. Burnaev, A. Stepanov, and D. Nikol, "Analysis of video game players' emotions and team performance: An eSports tournament case study," *IEEE J. Biomed. Health Inform.*, vol. 26, no. 8, pp. 3597–3606, Aug. 2022, doi: 10.1109/JBHI.2021.3119202.

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