Guest Editorial
Multimedia: The Biggest Big Data

MULTIMEDIA is increasingly becoming the "biggest big data" as the most important and valuable source for insights and information. It covers from everyone's experiences to everything happening in the world. There will be lots of multimedia big data—surveillance video, entertainment and social media, medical images, consumer images, voice and video, to name a few, only if their volumes grow to the extent that the traditional multimedia processing and analysis systems cannot handle effectively. Consequently, multimedia big data is spurring on tremendous amounts of research and development of related technologies and applications. As an active and inter-disciplinary research field, multimedia big data also presents a great opportunity for multimedia computing in the big data era. The challenges and opportunities highlighted in this field will foster some interesting future developments in the multimedia research and applications.

The goal of this special issue is to provide a premier forum for researchers to present their recent research results on multimedia big data. It follows the recent success event—the First IEEE International Conference on Multimedia Big Data (BigMM 2015) that took place at the Chinese National Convention Center in Beijing, China, from April 20–22, 2015 [1]. It also provides an important opportunity for multidisciplinary work connecting big data to multimedia computing. A total of forty papers were submitted to this special issue. After a rigorous review process, eight papers have been selected for publication. These accepted papers are divided into three categories. The first category includes three papers addressing the content analysis issues in multimedia big data. The second category is comprised of two papers addressing the multimedia big data retrieval issues. Finally, the third category has three papers discussing the delivery, streaming and authorization issues for multimedia big data. A brief description of the accepted papers in each of these categories is provided in the following for the convenience of the readers.

More and more multimedia data become available in various real-world applications, which makes the learning of multimodal representations a challenge. To address such a challenge, D. Wang, P. Cui, M. Ou, and W. Zhu presented a hashing-based orthogonal deep model to learn accurate and compact multimodal representations in their paper entitled "Learning Compact Hash Codes for Multimodal Representations Using Orthogonal Deep Structure." To show how to reduce the redundant information lying in the multimodal representations, the authors utilized the hashing-based model which can generate compact hash codes and the orthogonal structure which can reduce the redundant information lying in the codes. In addition, multimodal deep learning, which has shown its superiority in representing multimodal data due to its high nonlinearity representations, was adopted to demonstrate how to incorporate different modalities in the deep models. The experimental results on three real-world data sets showed that their proposed model achieved a substantial gain on the retrieval tasks in comparison to several existing algorithms.

In the second paper, "Connection Discovery Using Big Data of User-Shared Images in Social Media," M. Cheung, J. She, and Z. Jie proposed a technique to discover friendship among people on social networks. They built their approach based on the important observation that friends tend to share images with higher similarities. Utilizing this, an easier and more accessible alternative to the image tagging and social graphs was developed to discover user friendships.

In the third paper, "On-Road Pedestrian Tracking Across Multiple Driving Recorders" by K.-H. Lee and J.-N. Hwang, a new framework was proposed to track on-road pedestrians across multiple driving recorders, by mapping the task into a multi-label classification problem. As such, it determines each target belonging to one or several cameras' FOVs by considering the association likelihood of the target based on targets' motion cues and appearance features. Potentially, this framework provides a preliminary solution to analyze the exponentially increasing amount of on-board videos, which do definitely belong to a new field of multimedia big data due to the adoption of more and more self-driven vehicles.

How to effectively and efficiently retrieve the desired information from multimedia big data is yet another great challenge. The paper entitled "Large-Scale Image Retrieval Based on Compressed Camera Identification" by D. Valesia, G. Coluccia, T. Bianchi, and E. Magli addresses the problem of identifying photos that were taken using the same camera when their metadata related to the camera were not attached. Effectively, they tried to develop something similar to the fingerprint for each camera that they call Photo Response Non-Uniformity (PRNU), so as to characterize the effect of that camera on the photos captured by it. Using this measure, they also presented an approach to retrieve all photos taken by a camera.

Meanwhile, there is also an increasing volume of audios on the Internet. To facilitate fast retrieval in audio big data with the tradeoff between accuracy and efficiency, S. Yao, Y. Wang, and B. Niu presented an efficient cascaded filtering retrieval method in the paper entitled "An Efficient Cascaded Filtering Retrieval Method for Big Audio Data." Technologically, it consists of filtering with Fibonacci hashing, the middle fingerprint and thresholds to quickly select candidate audios, and refining with an accurate and robust fingerprint on the candidate audios. Experimental results on totally 500 000 audios showed that the proposed method could achieve a speed gain and a high accuracy.

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For the multimedia content providers such as YouTube, it is really one of major concerns to efficiently deliver multimedia big data to a large amount of users over the Internet, because currently a staggering 300+ hours of video content are being uploaded to the site every minute. Traditionally, these content providers often rely on the Content Delivery Network (CDN) infrastructure. However, some measurement studies show that a significantly large proportion of HTTP traffic results from bandwidth-intensive multimedia content circulating through Online Social Networks (OSNs). Thus we can exploit the user activity extracted from OSNs to reduce the bandwidth usage. Following this idea, I. Kilanioti proposed a dynamic content prefetching mechanism to CDNsim, a stand-alone CDN traffic simulator, in her paper entitled "Improving Multimedia Content Delivery via Augmentation With Social Information: The Social Prefetcher Approach." By taking the patterns of information transmission over OSNs into account, she demonstrated that the performance of CDNs could be improved remarkably.

In the paper entitled "Cloud-Assisted Live Streaming for Crowdsourced Multimedia Content," F. Chen, C. Zhang, F. Wang, J. Liu, X. Wang, and Y. Liu explored a big data problem of live streaming crowdsourced media, in which the number and distribution of the media sources can be highly dynamic, and the computational demand can be overwhelming for the system. An optimal framework was proposed to facilitate a cost-effective cloud service by utilizing adaptive and collaborative leasing strategies.

In the last paper entitled "A Framework for Composition and Enforcement of Privacy-Aware and Context-Driven Authorization Mechanism for Multimedia Big Data," A. Samuel, M. I. Sarfraz, H. Haseeb, S. Basalamah, and A. Ghafoor proposed a hybrid approach where privacy requirements were captured in an access control system. In addition, the authors presented a framework that could securely manage the access of multimedia big data for the composition and enforcement of the privacy policies as well as a methodology that could verify the privacy policy to ensure the correctness and logical consistency. Such a verification process was to make sure that sensitive security requirements were not violated when privacy rules were enforced. In their proposed approach, instead of a system or security administrator, it allows a user to compose the conflict free policies for his/her online multimedia data. A prototype called iPM (the Intelligent Privacy Manager) was implemented to demonstrate how their proposed framework achieved the dissemination and sharing of multimedia big data in a secure and private manner.

Finally, we would like to thank those individuals who have helped make this special issue possible. Many thanks to Prof. Chang Wen Chen, the Editor-in-Chief of the IEEE TRANSACTIONS ON MULTIMEDIA, for his strong support of the special issue. Most importantly, thank you to all of the authors who submitted manuscripts for consideration, and to the many dedicated reviewers who helped us arrive at our final choices.

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REFERENCES

[1] Y. Tian, S.-C. Chen, M.-L. Shyu, T. Huang, P. Sheu, and A. D. Bimbo, "Multimedia big data," *IEEE Multimedia Mag.*, to be published.

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Dr. Chen is a fellow of SIRI. He is the founding Editor-in-Chief of the *International Journal of Multimedia Data Engineering and Management*, and an Associate Editor or Editorial Board Member of the *IEEE MultiMedia Magazine*, IEEE TRANSACTIONS ON HUMAN-MACHINE SYSTEMS, and 13 other journals. He is the Chair of the IEEE Computer Society Technical Committee on Multimedia Computing and Co-Chair of the IEEE Systems, Man, and Cybernetics (SMC) Society's Technical Committee on Knowledge Acquisition in Intelligent Systems. He has been a General Chair and Program Chair for more than 50 conferences, symposiums, and workshops He has served as a member of three steering committees (including the IEEE TRANSACTIONS ON MULTIMEDIA) and a member

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Dr. Wang is the Editor-in-Chief of the *Journal of Communications*, and Vice President of the Asia–Pacific Signal and Information Processing Association. He chaired the IEEE Multimedia Communications Technical Committee, and the IEEE Technical Committee on Human Perception and Multimedia Computing. He also chaired IEEE GLOBECOM 2010, IEEE ICME 2011, IEEE VCIP 2014, IEEE ISM 2015, and ACM Multimedia 2017. He was a recipient of the IEEE MMTC Distinguished Service Award, as well as Leadership Awards from TCL, IEEE ICCCN, and other organizations.