

Special Issue on Situation Awareness in Intelligent Human-Computer Interaction for Time Critical Decision Making

Wei Wei

Xi'an University of Technology

Jinsong Wu

Universidad de Chile

Chunsheng Zhu

The University of British Columbia

■ **HUMAN-COMPUTER INTERACTION (HCI)** is an active field that focuses on the various interactions of human with machines. The HCI has been widely applied in multiple domains, such as artificial intelligence, computer vision, image and multimedia analysis, and cognitive and behavioral sciences. The objective of the HCI is to make the computer smart via receiving enough knowledge about the environment where it is deployed and reduce the human intervention aspect toward decision making. This enables development of high-end computers that are context aware and smart in making decisions

with reference to the context. Situation awareness of an intelligent HCI will decide the success and application of the solution across the real-world environment.

The aim of this special issue is to provide a platform on the topic of situation awareness in intelligent HCI for time critical decision making. This special issue has attracted a lot of scholars to contribute their original research works that were carried out toward advances in intelligent HCI and enhancing situation awareness. This special issue has attracted 15 submissions covering a wide range of situation awareness technologies and applications in the related area. After a serious peer-review by a team of experts, six papers were selected to be included in this special issue. The

Digital Object Identifier 10.1109/MIS.2019.2956692

Date of current version 18 March 2020.

six papers that cover broad topics are introduced briefly as follows.

The paper entitled “*A New Representation of Intuitionistic Fuzzy Systems and Their Applications in Critical Decision Making*,” provided by Son *et al.*, proposes a representation of intuitionistic fuzzy systems based on complex numbers (IFS-C) in the polar form by a new way to overcome the restrictions. Specifically, an intuitionistic fuzzy set is characterized by the two functions of modulus and argument. A new order relation, set-theoretic operations, and a new distance measure by the polar form of IFS-C are defined and investigated. The applicability of the proposal is illustrated by a new decision-making model called PDM. It is tested on the benchmark medical datasets in comparison with the existing methods. The experiments confirm the advantages of the proposal.

The paper entitled “*Research on Road Traffic Situation Awareness System Based on Image Big Data*,” provided by Zhu, takes the road traffic situational awareness system as the research object, and analyzes the information collection, processing, and analysis process of the road traffic situational awareness system through combining convolution neural network (CNN), situational awareness technology, database, and other technologies. The CNN, R-CNN (region convolutional neural networks), Fast R-CNN, and Faster R-CNN are compared for vehicle class classification and location identification in road image big data. Through the analysis and comparison of actual cases, the results show the application effect of the realized road traffic situational awareness system, which provides a scientific reference and basis for the establishment of modern intelligent transportation system.

The paper entitled “*Decision Making in IoT Environment through Unsupervised Learning*,” provided by Piccialli *et al.*, presents a study of unsupervised learning techniques applied on IoT data to support decision-making processes inside intelligent environments. To assess the proposed approach, the paper discusses two case-of-study in which the behavioral IoT data have been collected, also in a noninvasive way, in order to achieve an unsupervised classification that can be adopted during a decision-making process. The use of unsupervised learning techniques is acquiring a key role to complement the more traditional services with the

new decision-making ones supporting the needs of companies, stakeholders, and consumers.

The paper entitled “*Battlefield Image Situational Awareness Application based on Deep Learning*,” provided by Peng *et al.*, analyzes the structure and function of the battlefield situational awareness system, and concludes that in the whole situational awareness system, the discovery, category, and location analysis of situational elements, namely, object target, is the foundation and key to realize the function. On this basis, the paper establishes a battlefield situational awareness model based on YOLO model. Finally, five common objects on the battlefield (helicopter gunship, missile, tank, soldier, and gun) are classified and located, respectively. The YOLO model based on the CNN is used to process the input image, and then the position, category, and corresponding confidence probability of all objects in the image are obtained directly, which realizes end-to-end learning, greatly improves the speed of target detection, and lays a foundation for assessing the battlefield situation.

The paper entitled “*A Novel Siamese-based Approach for Scene Change Detection with Applications to Obstructed Routes in Hazardous Environments*,” provided by Santana *et al.*, proposes an approach that employs Siamese U-Nets to address the task of change detection, such that the model learns to perform semantic segmentation using background reference frames only. Therefore, any object that comes up into the scene defines a change. The experimental results show the robustness of the proposed model over the well-known public dataset CDNet2014. Additionally, the paper also considers a private dataset called “PetrobrasROUTES,” which comprises obstruction or abandoned objects in escape routes in hazardous environments. Moreover, the experiments show that the proposed approach is more robust to the noise and illumination changes.

The paper entitled “*Study on the Situational Awareness System of Mine Fire Rescue Using Faster Ross Girshick- Convolutional Neural Network*,” provided by Zhang *et al.*, uses the situational awareness system to study the rescue problem of mine fires, in order to reduce the casualties and economic losses caused by the mine fires. The CNN algorithm is inserted into the situational awareness system. By optimizing the algorithm, from R-CNN

model to Fast R-CNN model, the optimal model of Faster R-CNN is finally proposed and implemented. The practical case shows that the Faster R-CNN model and the situational awareness system can realize the situational awareness of mine rescue, which guarantees the success rate of operation images and improves the operational efficiency.

ACKNOWLEDGMENTS

The authors would like to thank the Editor-in-Chief, Professor Venkatramanan Siva Subrahmanian, for his support on this special issue. They also thank the whole editorial staff for their valuable and prompt support throughout the preparation and publication of this special issue. Meanwhile, we are also very grateful to all reviewers and authors for their contributions to this special issue.

Wei Wei is an associate professor in the School of Computer Science and Engineering, Xi'an University of Technology in China. He received the Ph.D. degree from the Xi'an Jiaotong University in 2010. He has authored/co-authored more than 100 papers published or accepted by the international conferences and journals. His research interests include wireless networks, sensor networks, image processing, mobile computing, distributed computing, pervasive computing, Internet of Things, sensor data, and cloud computing. He ran many funded research projects as principal investigator and technical members. He is a Senior Member of IEEE and CCF. He is the corresponding author of this article. Contact him at: weiwei@xaut.edu.cn.

Jinsong Wu is the vice-chair, Technical Activities, IEEE Environmental Engineering Initiative, a pan-IEEE effort under IEEE Technical Activities Board. He received the Ph.D. degree from the Department of Electrical and Computer Engineering, Queen's University, Canada. He was the founder and founding chair of the IEEE Technical Committee on Green Communications and Computing (TCGCC). He is also the co-founder and founding vice-chair of the IEEE Technical Committee on Big Data. He is the recipient of both 2017 and 2019 IEEE System Journal Best Paper Awards, the recipient of the 2018 IEEE TCGCC Best Magazine Paper Award for his co-authored paper, and is also the recipient of the IEEE Green Communications and Computing Technical Committee 2017 Excellent Services Award for excellent technical leadership and services in the Green Communications and Computing Community. He was the leading Editor and co-author for the comprehensive book, entitled "Green Communications: Theoretical Fundamentals, Algorithms, and Applications," published by CRC Press in September 2012. He is currently an IEEE Senior Member. Contact him at: wujs@ieee.org.

Chunsheng Zhu is a postdoctoral research fellow with the Department of Electrical and Computer Engineering, University of British Columbia in Canada. He received the Ph.D. degree in electrical and computer engineering from the University of British Columbia, Canada. He has authored more than 100 publications accepted or published by refereed international journals. His current research interests include Internet of Things, wireless sensor networks, cloud computing, big data, social networks, and security. Contact him at: chunsheng.tom.zhu@gmail.com.