Guest Editorial of the Special section on Customers Centric Communication and Networked Control for Intelligent Cyber-Physical Transportation Systems
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Guest Editorial of the Special Section on Customers Centric Communication and Networked Control for Intelligent Cyber-Physical Transportation Systems

Transportation accidents and traffic congestion issues are among the biggest today challenges due to the presence of a large number of vehicles manufactured worldwide. The following problems faced by road transport like inadequate road networks, highly congested city roads, difficulties of pedestrians, unmetalled roads, poorbridge conditions, parking difficulties, atmospheric pollution, environmental impact, and violation of traffic rules respectfully. Efforts across the world for Intelligent Cyber-Physical Transportation Systems (ICTS) are focused on addressing a range of problems including minimizing traffic accidents and fuel consumption, less congestion, reducing time spent on traffic jams, and enhancing transportation safety. ICTS systems cover the whole transportation-based information through advanced Customer-centric communication and networked control methods, such as intervehicle, vehicle-to-vehicle (V2V), and vehicle-to-roadside (V2R) via vehicular ad hoc network (VANET) communications. Cutting-edge technologies like Customer-centric communication, control, embedded systems, Internet of things, wireless sensor networks, data analytics, computer vision, cyber-physical systems (CPS), blockchain, learning analytics, and artificial intelligence, etc., have paved the way for intelligent transportation system (ITS). The special issue will focus on the role of advanced Customer-centric communication and networked control systems in Intelligent transportation systems to provide holistic information about the real-time conditions of the subjects (users, vehicles, roads, traffic, etc.) and their surroundings so that informed decision may be taken based on the data captured by these sensors via CPS. It aims to present the most important and relevant advances to overcome the challenges related to CNC-ICTS analytics, and processing through IoT-CPS. Particularly, authors are encouraged to submit their original research and review articles in theoretical, methodological, or practical focuses, such as simulation models, algorithms, experiments, and applications for big complex transportation systems. Statistically, twenty-one manuscripts are published in this special issue that directly or indirectly work on communication and control-based intelligent cyber-physical systems with intelligent interfacing and implementation techniques.

The first paper by M. Obayya et al. [1] presents a complete study and awareness of the uses of Deep learning models on Intelligent Transportation Systems, as well as demonstrates the development in Intelligent Transportation Systems research that has been owing to Deep learning studies. This paper offers a summary and taxonomy of current traffic forecast systems.

The second paper by H. Gupta et al. [2] proposes an artificial intelligence-based Anomalies detection scheme model employing a feature selection technique based on fuzzy and genetic algorithms and also uses the bio-inspired genetic algorithms Intelligent Water Drop and Biogeography-based Optimization for feature selection intending to detect malicious sessions in IoT networks.

The third paper by A. Chougule et al. [3] presents a Privacy-Preserving Asynchronous Federated Learning and vertical partitioning-based Algorithm that reduces the duration of idling at red lights and improves the fuel consumption of Intelligent Transportation Systems. Additionally, the authors introduce a technique that enhances the passing-vehicle ratio at the intersection and efficiently manages the traffic.

The fourth paper by H. N. AlEisa et al. [4] investigates whether deep learning can enhance the security of autonomous vehicles and other forms of smart transportation. Authors improve the smart transport network using the deep learning method, simulate it, and statistically study its data transmission economy, accuracy projections of the future, and path-switching strategy.

The fifth paper by M. A. Saleem et al. [5] proposes a secure access control protocol with conditional privacy for VANETs. Unlike other protocols, this protocol does not require the Trusted Authority’s involvement during authentication between vehicles and roadside units. Additionally, this protocol leverages pseudonym mechanisms to provide conditional privacy, enabling legitimate vehicles to remain anonymous while malicious ones can be tracked. The authors propose scheme is supported by both formal and informal security analyses and is secure against several known attacks in VANETs.

The sixth paper by Q. V. Khanh et al. [6] develops an efficient routing scheme that aims to enhance the performance and reduce energy consumption of self-organizing networks for Intelligent Transportation Systems in smart cities with low mobility speeds. The simulation results clearly show that the proposed algorithm performs better than conventional routing protocols in low-speed mobility scenarios.

The seventh paper by Y. Zhang et al. [7] proposes a Dual
channel attention Graph Attention network, termed DDGAT. Specifically, the traffic channel builds a sequential-based graph, where words are nodes and their co-occurrences are edges. In contrast, the emotion channel builds a syntactic-based graph with words as nodes and semantic dependencies as edges.

The eighth paper by J. Huang et al. [8] designs an interference avoidance resource allocation strategy based on a hypergraph in customer-centric communication for Intelligent Cyber-physical Transportation Systems. The overlapping interference relationship between customers is modeled in the interference model by hypergraph theory, the interference avoidance resource allocation under complex interferences is generalized to a hypergraph vertex strong coloring problem.

The ninth paper by G. ALMahadin et al. [9] suggests a deep learning model for anomaly detection based on GRU over VANET network traffic to address this challenge. To further improve the accuracy of the proposed model, a new semi-supervised technique for detecting VANET network activity anomalies called SEMI-GRU has been proposed.

The tenth paper by H. Yan et al. [10] proposes a solution to the service caching problem in Intelligent Cyber-Physical Transportation Systems, named SFT-SCAR with the assistance of digital twins. A digital twins-supported service providing a framework for Intelligent Cyber-Physical Transportation Systems is designed. Then, a graph attention network-based service request flow prediction scheme and an asynchronous advantage actor-critic-based service caching scheme are presented. Besides, the generated caching strategies are simulated in the digital twins of Intelligent Cyber-Physical Transportation Systems to evaluate the performance of these strategies.

The eleventh paper by F. Ullah et al. [11] develops a novel network intrusion detection system for VANET that leverages Spark-based big data optimization and transfer learning. This paper delivers the best detection results for a variety of attacks including audio, HTTP, BruteForce, web, and others.

The twelfth paper by Q. Lai et al. [12] proposes a Feature attention mechanism to search and promote significant features. Furthermore, the Feed-Forward Network is replaced with a Routing module for a deeper but less-parameter network.

The thirteenth paper by Y. Ren et al. [13] presents a new path-tracking control method for autonomous ground vehicles. A novel fuzzy switching controller is designed, which can realize cooperative control of multiple fuzzy controllers according to specific switching rules by reading the change in vehicle speed.

The fourteenth paper by J. He et al. [14] propose an Autonomous Underwater Vehicle On-board Control Scheme based on multi-agent reinforcement learning and cloud computing technology to serve consumer-level Autonomous Underwater Vehicles, in which the local perception information preprocessed by each Autonomous Underwater Vehicle is uploaded to the cloud center for data fusion in real-time and a centralized value function is designed to optimize the global decision.

The fifteenth paper by H. Peng et al. [15] proposes an ambient backscatter communication symbiotic ITS. To evaluate the system performance, we derive the expressions in terms of detection error probability, outage probability, effective covert rate, and energy efficiency.

The sixteenth paper by P. Liu et al. [16] establishes the characteristics of the vertical parking process and C-type parking constraints, a two-stage vertical parking dynamic optimization problem. Simulation experiments show that the proposed method can effectively obtain vertical parking trajectories with fast computation and good adaptability.

The seventeenth paper by F. Hasan et al. [17] focuses intention awareness on two data sources and has also implemented the multi-head attention mechanism to achieve interaction awareness to achieve accurate future trajectory predictions. The proposed method has been trained and evaluated with publicly available datasets.

The eighteenth paper by P. Liu et al. [18] integrates Federated Learning into a Multimodal Deep Learning framework to protect participants’ privacy while achieving better performance in recommending driver breaks. The experimental findings demonstrate that the proposed method not only outperforms other existing approaches in terms of providing effective driver break recommendations but also prioritizes the privacy of the individuals involved.

The nineteenth paper by D. Cao et al. [19] focuses on a new Reservation-Based Multi-Source Distributed Offloading strategy. To minimize the long-term average task completion latency of the system, this strategy employs a Greedy Randomized Adaptive Search Procedures framework in dealing with the problem of multi-source tasks competing for limited computing resources and uses the reservation-based Sequential Quadratic Programming algorithm to achieve unequal task segmentation to maximize system performance.

The twentieth paper by C. Tang et al. [20] presents the optimization problem into per-slot optimization subproblems. The authors propose an effective algorithm with low time complexity to solve these subproblems in a slot-by-slot manner and evaluate the performance of our approach through extensive simulations, demonstrating that our method outperforms the baseline approaches in various aspects.

The final paper by M. Aljebreen et al. [21] provides a robust traffic prediction solution with direct applications in smart cities and real-time traffic management. To evaluate the model’s efficacy, the author conducted an empirical case study using the Enhanced Next Generation Simulation dataset, which
offers highly granular vehicle trajectory data.

All twenty-one papers tackle different but extremely relevant domain problems of communication and control, and intelligent cyber-physical systems in the context of Consumer Electronics. We hope the special issue will raise awareness in the scientific community, by presenting and highlighting the advances and latest novel and emerging technologies, implementations, and applications. We thank the authors and the reviewers for their contribution to this Special Section. We are grateful to the Editor-in-Chief for having allowed us to serve as Guest Editors and for his guidance throughout the whole process.

APPENDIX: RELATED ARTICLES


Best wishes,

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Chinmay Chakraborty, (SM’21) is an Assistant Professor at Birla Institute of Technology, Mesra, India. Dr. Chakraborty completed a Post-doctoral fellowship at the Federal University of Piauí, Brazil, and also visited the University of Malta in Europe. He has a diverse academic and professional background with experience in various research and teaching positions. Dr. Chakraborty completed a Post-doctoral fellowship at the Federal University of Piauí, Brazil, and also visited the University of Malta in Europe. His main research interests include the Internet of Things, AI/ML, Communication & Computing, and Intelligent Systems. He serves as an Editorial Board Member for various journals and conferences, and holds positions as an Associate Editor for IEEE TII, Indonesian Journal of Electrical Engineering and Computer Science, Journal of Biomedical and Biological Sciences, HCIS, Springer BMC Bioinformatics, JIFS, Int. J. of End-user Computing and Development, Int. Journal of Strategic Engineering, and Lead Guest Editor for several IEEE and ACM publications like Lead Guest Editors of IEEE-JBHI, IEEE-TCIE, IEEE-TII, IEEE SMC Magazine, IEEE TCSS, ACM-TALIP, ACM-JDIQ, Hindawi- JHE, Mary Ann Liebert - Big Data J., IGI-IJEHMC, Springer – MTAP, CMC, Inderscience- IJNT, Journal of Medical Imaging and Health Informatics, Elsevier-Healthcare Informatics, IJMSSC, CAMES, etc., Guest Editors of MDPI-FI, Wiley-ITL, BSR, Springer-ANT, IJSNE, EDS, etc. and, Lead Book Series Editor of CRC- Advances in Smart Healthcare Technologies.

Anh-Tu Nguyen (M’18, SM’21) is an Associate Professor at the INSA Hauts-de-France, Université Polytechnique Hauts-de-France, Valenciennes, France. He received the degree in engineering and the M.Sc. degree in automatic control from Grenoble Institute of Technology, Grenoble, France, in 2009, and the Ph.D. degree in automatic control from the University of Valenciennes, Valenciennes, France, in 2013. He serves as an Associate Editor for top-level international journals, including IEEE/ASME Transactions on Mechatronics, IEEE Transactions on Intelligent Transportation Systems, IFAC journal Control Engineering Practice, ISA Transactions, and a Guest Editor for special issues in various international journals. His research interests include robust control and estimation, cybernetics control systems, human-machine shared control with a strong emphasis on mechatronics applications.

Houbing Herbert Song (M’12-SM’14-F’23) received the Ph.D. degree in electrical engineering from the University of Virginia, Charlottesville, VA, in August 2012. He is currently a Professor, the Founding Director of the NSF Center for Aviation Big Data Analytics (Planning), the Associate Director for Leadership of the DOT Transportation Cybersecurity Center for Advanced Research and Education (Tier 1 Center), and the Director of the Security and Optimization for Networked Globe Laboratory (SONG Lab, www.SONGLab.us), University of Maryland, Baltimore County (UMBC), Baltimore, MD. He serves as an Associate Editor for IEEE Transactions on Artificial Intelligence (TAI) (2023-present), IEEE Internet of Things Journal (2020-present), IEEE Transactions on Intelligent Transportation Systems (2021-present), and IEEE Journal on Miniaturization for Air and Space Systems (J-MASS) (2020-present). Dr. Song is an IEEE Fellow (for contributions to big data analytics and integration of AI with Internet of Things), an American Association for the Advancement of Science (AAAS) Fellow, an Asia-Pacific Artificial Intelligence Association (AAIA) Fellow, an ACM Distinguished Member (for outstanding scientific contributions to computing), and a Full Member of Sigma Xi. Dr. Song has been a Highly Cited Researcher identified by Web of Science since 2021. He is an ACM Distinguished Speaker (2020-present), an IEEE Communications Society (ComSoc) Distinguished Lecturer (2024-present), an IEEE Vehicular Technology Society (VTS) Distinguished Lecturer (2023-present) and an IEEE Systems Council Distinguished Lecturer (2023-present). Dr. Song received Research.com Rising Star of Science Award in 2022, 2021 Harry Rowe Minno Award bestowed by IEEE Aerospace and Electronic Systems Society, and 10+ Best Paper Awards from major international conferences.

Chao Huang (M’20, SM’24) Chao Huang is a Research Assistant Professor at the Department of Industrial and System Engineering, The Hong Kong Polytechnical University. Her research interests are human-machine collaboration, fault tolerant control, mobile robot (EV, UAV), and path planning and control. Prior to Polyu, she was a research fellow at Nanyang Technological University (NTU) and the National Institutes of Informatics (NII). Her research interests include human – machine collaboration, fault-tolerant control, mobile robot (EV, UAV), and path planning and control. She is now an Associate Editor of IEEE Transactions on Intelligent Vehicles (TIV) and IEEE Transactions on Transportation Electrification (TTE).