Edge-Enabled Consumer Technologies in Physical Environments

From the Editor's Desk

Edge-enabled Consumer Technologies in Physical Environments

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I WELCOME THE READERS to the third issue of 2026, the May/June edition of *IEEE Consumer Electronics Magazine (MCE)*.

EDGE-ENABLED CONSUMER TECHNOLOGIES IN PHYSICAL ENVIRONMENTS

Consumer electronics and consumer technologies are increasingly extending beyond personal devices and domestic settings, becoming integral components of systems operating directly within physical environments. From urban intersections and public venues to construction sites and emergency scenarios, modern consumer platforms are expected to function reliably under real-world constraints, including limited computational resources, latency requirements, and dynamic operating conditions. This shift reflects a broader transition toward distributed processing at the network edge and integration between digital services and the physical world.

The articles featured in this issue capture this evolution by addressing how consumer technologies can be designed, deployed, and scaled to support real-time operation in complex environments, providing insights into consumer technologies that operate close to where data are generated and interact directly with physical spaces.

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FEATURE PAPERS

Zeng et al. [1] present a map-free localization approach for mobile construction robots operating in indoor environments. By combining building information modeling point clouds with an improved three-dimensional normal distributions transform, the framework enables accurate pose estimation with lightweight computation, supporting reliable edge-based operation.

Zhang et al. [2] introduce AiGuard, a monitoring platform designed for consumer-oriented gas station operations. By integrating real-time video analysis and behavior recognition, the system enhances safety management, service quality, and operational efficiency in service environments.

SPECIAL SECTION ON IEEE INTERNATIONAL CONFERENCE ON CONSUMER ELECTRONICS 2025

This Special Section includes six articles that are extended versions of selected papers from the *43rd IEEE International Conference on Consumer Electronics*, held in Las Vegas, NV, United States, January 11–14, 2025.

Majumdar et al. [3] present a voice-controlled autonomous drone platform for emergency medical response, enabling hands-free operation in time-critical

situations.

Miyaji et al. [4] propose a safety support network system that employs uncrewed aerial vehicles equipped with three-dimensional LiDAR to monitor urban intersections, enhancing the detection of vehicles and pedestrians.

Eimon et al. [5] address the challenge of deploying machine vision functionality across edge and cloud resources under bandwidth and privacy constraints. Their article introduces the MPEG Feature Coding for Machines Test Model, demonstrating reductions in transmitted data rates while maintaining task performance.

Sato et al. [6] focus on real-time processing of large-scale spatial data for urban services. The proposed method estimates spatial importance within point cloud streams using window-based spatiotemporal aggregation, reducing computational and communication overhead.

Yamazaki et al. [7] present a three-dimensional mobile crowdsensing framework for sustainable urban digital twins. By combining active, gamified data collection with passive wearable-based approaches, the framework illustrates how consumer devices can collaboratively generate and integrate large-scale spatial representations.

Wang et al. [8] introduce Gen-Presenter, an interactive presentation system designed for consumer-facing public installations such as museums and exhibitions. The system delivers adaptive, multimodal content through edge-based processing, supporting engaging interactions in shared physical spaces.

I would like to thank the Conference Chairs, Hideki Tode and Jing-Ming Guo, and the TPC Chairs and Co-Chairs Kiyoshi Ueda, Yu-Cheng Fan, Kim-Fung Tsang, Norbert Herencsar, and Kazuhiro Kikuma for the sincere effort and hard work dedicated to the conference, which translates into this Special Section.

LOOKING FORWARD

This issue brings together examples of consumer technologies operating at the edge of physical environments. The presented works highlight directions for future research and development aimed at scalable, real-world consumer systems.

APPENDIX: RELATED ARTICLES

1. L. Zeng, S. Cheng, S. Guo, and H. Gao, "Map-free construction robot localization via building information modeling point clouds and an improved 3D normal distributions transform," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3633867.
2. M. Zhang, X. Wu, G. Xiao, R. Li, and T. He, "AiGuard: AI-powered gas station intelligent monitoring platform," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3638726.
3. S. Majumdar, A. Awasthi, S. Kirkley, and B. B. Mallik, "Voice-controlled drones for emergency response: AI at the frontline," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2026.3660007.
4. H. Miyaji, T. Shudo, and H. Yamamoto, "Safety support network system using overhead sensing by an uncrewed aerial vehicle equipped with 3D LiDAR," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3601303.
5. M. E. H. Eimon, J. Merlos, A. Perera, H. Kalva, V. Adzic, and B. Furht, "Feature coding for scalable machine vision," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3630304.
6. J. Sato, R. Shimizu, Y. Umemoto, T. Miyoshi, T. Yamazaki, and R. Shinkuma, "Real-time spatial importance estimation using window-based spatiotemporal aggregation," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3598488.
7. T. Yamazaki, K. Watanabe, T. Kase, K. Hasegawa, K. Saida, and T. Miyoshi, "A 3D mobile crowdsensing framework for sustainable urban digital twins," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3598925.
8. M.-S. Wang, S. A. Bhat, J.-F. Li, and M.-C. Chen, "Gen-Presenter: An interactive artificial Internet of Things presentation system with retrieval-augmented generation-supported large language models," *IEEE Consum. Electron. Mag.*, vol. 15, no. 3, pp. 1–12, May/June 2026, doi: 10.1109/MCE.2025.3591257.

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