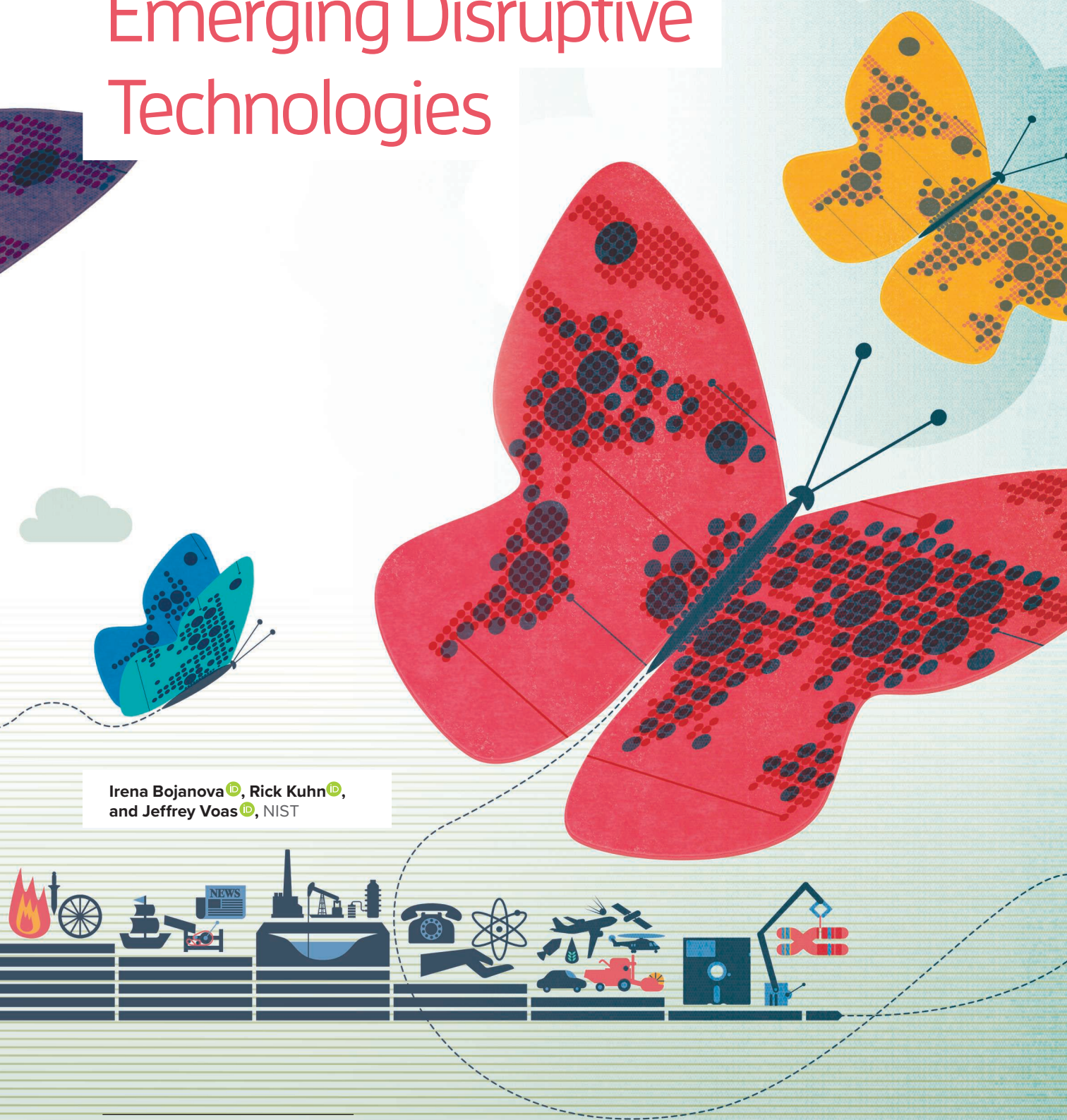
Emerging Disruptive Technologies



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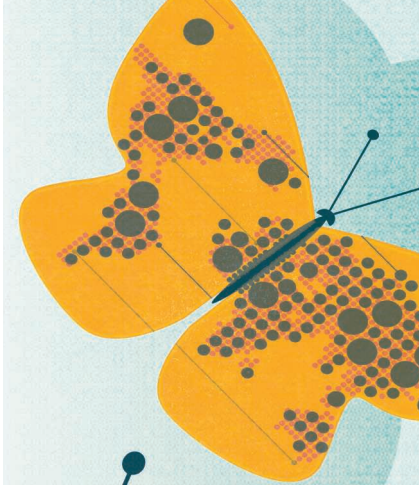

Emerging technologies typically lead to disruptive innovation and catalyze transformation in how businesses compete, how society evolves, and how people live. This special issue focuses on new emerging technologies and exciting opportunities for technology-enabled transformation.

After decades of steady progress, the digital revolution is now fast-forwarding. Disrupted by the COVID-19 pandemic and the demands of new technological advances, businesses and society need a technological reset and adoption of nontraditional approaches to innovation and efficiency. This special issue of *Computer* focuses on very new emerging technologies and exciting opportunities for technology-enabled transformation.

Change is possible through steady continuous improvement and add-ons or through short-term, very exciting, high-impact disruptive innovations that have long-term effects on the world. Most emerging technologies lead to disruptive innovation and catalyze transformation in how businesses compete, how society evolves, and how people live. There is a need for guidance on the impact of these technologies and understanding how to use them to drive competitive differentiation.

Focus on more holistic approaches is also essential as no person, company, industry, or part of society stands on its own. They should be familiar with these technologies, their potential for impact, the opportunities that they present, and their limitations. They should plan to exploit these technologies as they become commercially available.

This special issue presents five peer-reviewed articles, focusing on interesting questions in applying 1) artificial intelligence (AI) and machine learning (ML) with natural language processing (NLP) and deep learning (DL), 2) cloud computing and big data, 3) Internet of Things (IoT) and AI for IoT as a service (AIoTaS), 4) virtual reality (VR) and augmented reality (AR), and 5) nonfungible tokens (NFTs). These articles review state-of-the-art technology applications and guidance from academic and industry viewpoints.

AI is any technique enabling computers to mimic human behavior; it focuses on building smart algorithms.

DISCLAIMER

These opinions, recommendations, findings, and conclusions do not necessarily reflect the views or policies of NIST or the U.S. Government.

APPENDIX: RELATED ARTICLES

A1. C. H. C. Duarte, "Authorship and peer review in the era of artificial intelligence," *Computer*, vol. 56, no. 12, pp. 32–41, Dec. 2023, doi: 10.1109/MC.2023.3311729.

A2. C. Xia and Y. Sugiura, "Virtual sensors with 3D digital human motion for interactive simulation," *Computer*, vol. 56, no. 12, pp. 42–54, Dec. 2023, doi: 10.1109/MC.2023.3239344.

A3. S. Fleury, F. Bernard, R. Paquin, P. Blanchard, and S. Richir, "Augmented and virtual reality simulation in industry," *Computer*, vol. 56, no. 12, pp. 55–64, Dec. 2023, doi: 10.1109/MC.2023.3283311.

A4. Y.-D. Lin, Y.-C. Lai, D. Sudyana, and R.-H. Hwang, "Artificial intelligence for internet of things as a service: Small or big data, private or public model, centralized or federated learning?" *Computer*, vol. 56, no. 12, pp. 65–79, Dec. 2023, doi: 10.1109/MC.2023.3303370.

A5. C. Mulligan, T. Silva, and J. Jorge, "A research agenda for NFTs," *Computer*, vol. 56, no. 12, pp. 80–90, Dec. 2023, doi: 10.1109/MC.2023.3271021.

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ML is the ability to learn without being programmed; it focuses on teaching an algorithm to do the task at hand. A subset of ML is DL, which extracts patterns from data using neural networks. NLP includes language translation and the ability to turn text or audio speech into encoded, structured information, based on an appropriate ontology.

The first article[A1] relates to uses of AI, ML, DL, and NLP. It discusses the future of authorship and peer review specifically of scientific research, grant, and statistical process quality assurance, considering the recent advances in AI. The author discusses standards families, policy recommendations, and technology regulations to foster AI usage, governance, and trust. Then the author lists the challenges and opportunities to authorship and peer review in the era of AI, suggests how to deal with them, and concludes by recommending enforcement of fundamental rights through new legislation on AI systems.

VR is a computer-generated 3D environment, in the form of computer graphics and 360° video, that responds to a person's actions, for example, via immersive head-mounted displays. Hand and body tracking and haptic feedback (including of machinery) are achieved via gesture recognition or handheld controllers. AR is the real-time use of information from virtual enhancements of real-world objects; it integrates and adds value to users' interaction with the real world, versus a simulation.[1] The next two articles relate to uses of VR and AR.

Xia and Sugiura[A2] discuss the reproduction of human motions by digital humans in a virtual environment and how collecting low-dimensional sensor data from 3D digital human motions can help change the development process for traditional human-motion-related systems. They state that such an approach provides an opportunity to decrease the dependency on real-world data and increase the flexibility in the corresponding uses, thus helping build a more reliable, customized, and lightweight user-oriented application.

Fleury et al.[A3] discuss the expansion in the use of simulators in industry due to technological improvements. They identify three categories of use, training, designing products, and testing processes, and provide examples of projects conducted and indications of relevant use cases. They stress the collaborative dimension for these categories and conclude that the major areas of improvement in such immersive simulators are better use of haptic devices and AI.

Cloud computing uses Internet technologies to deliver as a service scalable and elastic IT-enabled capabilities. IoT is a network of physical objects with embedded technology for communication and sensing or interaction with their internal states or the external environment.[1] The article by Lin et al.[A4] relates to cloud computing and IoT. It presents and studies a generic framework for constructing three possible services of AIoTaS: small private, big public, and small public. By mapping the training and federation tasks to the cloud-edge-fog paradigms, they identify 31 possible mappings, comprising seven small private services, seven big public services, and 17 small public services. They suggest that the majority of AIoTaS applications might be deployed as big public services, with only the most sensitive applications deployed as small private services, and that in terms of operational costs, employing only the edge is preferable

for running services on architecture. The authors conclude that additional work is needed to develop an effective service framework for managing the operations of the distributed AIoTaS architecture.

A blockchain is a shared (by all participants in a network) expanding list of irrevocable transactional records that are cryptographically signed. Each record is time-stamped and references the previous transactions, which allows tracing back any transaction of any participant. An NFT is a unique programmable digital item based on blockchain that proves publicly the ownership of digital assets: digital art or music or tokenized physical items (for example, houses or documents). NFTs store data and logic and may link for storage to off-chain records.[1] Mulligan et al.[A5] provide a systematic literature review of the current research in NFTs. Their analysis of 121 published articles investigated the areas of NFT research covered and the levels of interest, as measured by published article count, of topics such as data provenance, economics, security, and others. This analysis enabled the identification of research gaps and opportunities for improving knowledge in the NFT field.

We hope you enjoy these articles, as well as this issue's insightful column/department articles. We thank all of the authors, guest editors, and reviewers for their contributions and our readers and subscribers for their continued support.

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1. "Gartner glossary." Gartner. Accessed: Sep. 8, 2023. [Online]. Available: https://www.gartner.com/en/glossary

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