

# IT Empowering Rescuers and First Responders in Saving Lives

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One could easily argue that there's no better application of technology than technology designed to help first responders (FRs), which is the premise of this special issue of *IT Professional (IT Pro)*. When the idea was first discussed, there was broad agreement that if a special issue could enable—even in a small way—the important work FRs do, then the effort would be worthwhile. We proceeded with a call for papers and received a number of excellent responses but ultimately selected four that we believe could impact how FRs do their important work, which seems to be increasingly complicated and consequential. There's no denying that the number and complexity of crisis situations are increasing and that the need for technology-enabled responses is skyrocketing.

The articles in this special issue have some things in common: data, architectures, wearables, communications, and situation awareness. You will notice that there's an emphasis on internal and external (individual and team) communications requirements enabled and enhanced by the collection of real-time data. You will notice that "connectivity" and "awareness" are essential to effectiveness and, that the Internet of Things, augmented reality (AR), artificial intelligence (AI), and other technologies link FRs and enable them to "see" and "understand" where they are and what they're doing.

The challenges are obvious: when a crisis occurs, conventional infrastructure often crashes, leaving FRs "blind." Crises also overwhelm FRs, who need hardware and software capabilities that are immediate and powerful.

So let's turn our attention to the articles, which describe some unique approaches to how technology can help FRs resolve complex crises.

The first article, by Wright et al.,<sup>A1</sup> describes how FRs can communicate without the infrastructure we all take for granted: when an event cripples existing real-time communications, data sharing, and what the military calls *command and control* (where the amount of information generated can be overwhelming for both

the FRs and the infrastructure-less network that connects them). The authors develop an architecture that can prioritize and regulate information before it's sent to FRs, with a communications platform that allows prioritized information to be shared in an efficient and infrastructure-less way. This architecture is important for several reasons. First, the assumption is that situations that require first responses often paralyze existing infrastructures just as the need for data, information, and knowledge explodes. This conundrum defines most severe situations. The authors develop a mesh architecture for FRs that essentially makes them independent actors in the response process. They integrate "internal" communications across devices in real time, which is key to their success: the integration of data through a communications gateway.

The second article, by Kaiser et al.,<sup>A2</sup> looks at the role that self-localization plays in the coordination of FRs. The authors describe a system that combines self-localization, communication of FR locations, 3-D building reconstruction or floorplans, and visualization. Indoor navigation is based on inertial sensors and builds on simultaneous localization and mapping. It is capable of using any information about, for example, building layouts as prior information for enhancing indoor positioning, georeferencing the positions, and finally, visualizing the results in an interactive tool. The system they develop is capable of addressing situation assessment emergencies by visualizing FRs' locations inside buildings to minimize operational risks. The authors promise—in future work—to automate previous map generation and the setup process to minimize the time to operation during emergency operations. They describe how a global navigation satellite systems receiver will also provide outdoor positions.

The importance of this work cannot be overstated. Knowing where a person is physically located during a crisis as well as how to maneuver in that environment will save the lives of both FRs and those threatened by a crisis.

The third article, by García et al.,<sup>A3</sup> looks at helmet technology, which uses AR to enhance FRs' situational awareness, which displays data about the environment, location, team status, objectives, and more, despite the

## ALSO IN THIS ISSUE

### FEATURES

Welcome to the year-end edition of *IT Pro*. It is hard to believe that we are preparing for a 25th anniversary edition in January/February of 2024. As was the case in the highly transformative year 2023, AI and networking remain topics of ongoing interest in the IT community.

Our first feature article, by Majeed and Hwang,<sup>A5</sup> exemplifies the enduring interest in AI. The article compares model-centric AI, criticized for code meddling and high overhead, to the newer data-centric AI, which seeks to improve data versus the code. The authors demonstrate the advantages of data-centric AI. The two other feature articles examine networked environments. Mohamed Rahouti et al.<sup>A6</sup> discuss an approach that reduces overhead in multiple robots to reach a home destination through shared, blockchain-protected homing vectors derived from the teaming robot's wide fields of view. Kim and Park<sup>A7</sup> explore the use of exponential random graph modeling to track cryptocurrency activities on Twitter (now X) that use memes as a branding mechanism. The study reveals the potential for yielding misinformation and artificially inflated cryptocurrency valuation.

### COLUMNS AND DEPARTMENTS

This edition's departments and columns return to the AI theme. Nir Kshetri<sup>A8</sup> examines the future of education in his popular IT Economics department. Here, Kshetri evaluates the impact of generative AI (GAI) on primary and secondary education and their associated administrative tasks.

Next is an IT Trends article by Andrew Park et al.<sup>A9</sup> The authors take a lengthy but satisfying deep dive into numerous potential pitfalls surrounding the adoption of GAI in business.

Along similar lines is Stephen Andriole's<sup>A10</sup> Life in the C-Suite article. Here, Andriole uses Chat-GPT and Bard to establish the importance of executives understanding what machine learning and GAI can and cannot do.

Always insightful, George Strawn<sup>A11</sup> profiles Herman Holorith in his Mastermind article. Holorith developed the punch-card tabulating machine, eventually leading to the creation of the IBM Corporation.

Finally, Giuseppe De Palma et al.<sup>A12</sup> present an article that shows how to achieve fine-grained serverless scheduling policies through the function-as-a-service cloud execution model leveraging Allocations Priority Policy language. We commend all these thought-provoking articles hope you enjoy reading them.

environment challenges of deploying real-time AR. The authors describe a "smart helmet," which includes an infrared camera, a power source, processing hub, and near-eye AR display. The processing hub runs infrared image enhancement, object-recognition AI algorithms, and an AR interface.

As the authors suggest, "the Smart Helmet system has the potential to revolutionize rescue scenarios and improve the safety and effectiveness of first responders." But the helmet is not perfect. The authors know that battery life and processing power should be improved. Overheating remains a serious problem, and the AR interfaces need adaptation to more hardware, software, and conditions. As always, continuous testing will enable development and deployment.

Smart helmets may be key to the survival of FRs. The ability to know a person's location and how to "see" the situation through AR-enabled awareness, like

the ability to self-localize, will help FRs survive and perform lifesaving tasks.

The fourth article, by Ganesan and Jagatheesaperumal,<sup>A4</sup> focuses on the importance of reliable and secure wireless communication, "especially in emergency situations that require the use of smart wearables." The authors develop a decentralized/real-time approach to accessing data from wearables with blockchain and 5G/6G networks. They describe the benefits of using massively populated and real-time-streaming, data-intensive, federated-learning (FL)-enabled beyond 5G (B5G)/6G systems to provide emergency services with real-time access to relevant information. By integrating blockchain and "responsible" AI frameworks, they want to ensure the security and trustworthiness of communication channels. The solution addresses sovereignty concerns and has the potential to transform emergency response.

## APPENDIX: RELATED ARTICLES

- A1. P. Wright, I. Asani, N. Pimenta, P. Chaves, W. Oliff, and G. Sakellari, "Infrastructure-less prioritized communication platform for first responders," *IT Prof.*, vol. 25, no. 6, pp. 29–37, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3338450](https://doi.org/10.1109/MITP.2023.3338450).
- A2. S. Kaiser, S. Sand, M. Linkiewicz, H. Meißner, D. Baumbach, and R. Berger, "An overall first responder tracking and coordination framework," *IT Prof.*, vol. 25, no. 6, pp. 38–44, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3339449](https://doi.org/10.1109/MITP.2023.3339449).
- A3. A. F. García et al., "Smart helmet: Combining sensors, AI, augmented reality, and personal protection to enhance first responders' situational awareness," *IT Prof.*, vol. 25, no. 6, pp. 45–53, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3335901](https://doi.org/10.1109/MITP.2023.3335901).
- A4. P. Ganesan and S. K. Jagatheesaperumal, "Revolutionizing emergency response: The transformative power of smart wearables through blockchain, federated learning, and beyond 5G/6G services," *IT Prof.*, vol. 25, no. 6, pp. 54–61, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3323714](https://doi.org/10.1109/MITP.2023.3323714).
- A5. A. Majeed and S. O. Hwang, "Technical analysis of data-centric and model-centric artificial intelligence," *IT Prof.*, vol. 25, no. 6, pp. 62–70, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3322410](https://doi.org/10.1109/MITP.2023.3322410).
- A6. M. Rahouti et al., "A decentralized cooperative navigation approach for visual homing networks," *IT Prof.*, vol. 25, no. 6, pp. 71–81, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3323865](https://doi.org/10.1109/MITP.2023.3323865).
- A7. J. H. Kim and H. W. Park, "Identifying networked patterns in memecoin Twitter accounts using exponential random graph modeling," *IT Prof.*, vol. 25, no. 6, pp. 82–89, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3326002](https://doi.org/10.1109/MITP.2023.3326002).
- A8. N. Kshetri, "The future of education: Generative artificial intelligence's collaborative role with teachers," *IT Prof.*, vol. 25, no. 6, pp. 8–12, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3333070](https://doi.org/10.1109/MITP.2023.3333070).
- A9. A. Park et al., "Nothing is harder to resist than the temptation of AI," *IT Prof.*, vol. 25, no. 6, pp. 13–20, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3340529](https://doi.org/10.1109/MITP.2023.3340529).
- A10. S. J. Andriole, "An executive guide to AI, machine learning, and generative AI—with some help from ChatGPT and Bard," *IT Prof.*, vol. 25, no. 6, pp. 21–25, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3333073](https://doi.org/10.1109/MITP.2023.3333073).
- A11. G. Strawn, "Masterminds of punched card data processing: Herman Hollerith and John Billings," *IT Prof.*, vol. 25, no. 6, pp. 90–93, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3333074](https://doi.org/10.1109/MITP.2023.3333074).
- A12. G. De Palma et al., "Formally verifying function scheduling properties in serverless applications," *IT Prof.*, vol. 25, no. 6, pp. 94–99, Nov./Dec. 2023, doi: [10.1109/MITP.2023.3333071](https://doi.org/10.1109/MITP.2023.3333071).

As the authors describe, "the use of blockchain-driven FL and B5G/6G technology in wearable devices has the potential to significantly enhance emergency response, improving both the safety and efficiency of these technologies." This approach enables data sharing across multiple devices without, as the authors suggest, compromising privacy.

This article dives deep into several technologies that will improve crisis management. The importance of this examination highlights the need to track emerging technologies and constantly assess the impact they might have on the work that FRs perform. This task/technology "matching" process explains what all of the contributors to this special issue have done: they've all looked at crisis processes and matched the technologies to the processes that they believe will

help save the lives of FRs and the people they're trained to save.

All four articles represent a package that describes how IT empowers rescuers and FRs in saving lives. They understand FR requirements and propose technology solutions that are more than workable, and in many cases, are ready for field testing. *IT Pro* is proud to offer them to its readers and hope that they help save lives.

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