Mersivity: Wearable Artificial Intelligence and Spatial Extended Reality for Humanity and Earth

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Extended reality/extended intelligence (XR/XI), often known simply as XR, is not merely a broad umbrella term to encompass and interpolate between the other realities [virtual reality (VR), augmented reality (AR), mediated (or mixed) reality (MR), the Internet of Things (IoT), the metaverse, spatial computing, etc.]; it also extrapolates (extends) beyond these realities. An XR eyeglass device allows the wearer to see a dynamic range of more than a billion to one, e.g., to see in the dark while simultaneously safely viewing an electric welding arc. With XR we can also see sound waves, radio waves, and the rotating magnetic fields inside motors. XR has real industrial significance and is not merely a concept from academia. This article summarizes a panel at the 2025 IEEE International Conference on Consumer Electronics (ICCE 2025) on *mersivity* (immersivity and exmersivity) of XR with an emphasis on its near-perfect spatial alignment with reality, especially useful for wearable technologies. Mersivity is a socio–cyberphysical system that connects us to each other ("Humanity") and to our surroundings/environment ("Earth," "Water," and "Air"). Mersivity has a positive impact on society as we make technology reliable, robust, and hands free so we can go for a hike in the wilderness or go for a swim with the technology serving us, rather than keeping us prisoner in an office or living room. We call upon creators of technology to embrace the principles of mersivity and create technology that safely connects us with our surroundings and extends rather than replaces our intelligence.

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The inaugural panel session, "Mersivity: Wearable Artificial Intelligence and Spatial Extended Reality for Humanity and Earth," held during ICCE 2025, highlighted the importance of technology that connects us to each other and to our surroundings (i.e., mersivity) through wearable artificial intelligence (AI) and spatial XR. As XR/XI undergoes growth, it presents challenges for both the industry and end users. The panel brought together the world's leading experts on wearables and XR to define the future of mersivity, the new field at the nexus of socio–cyberphysical technologies of encapsulation (e.g., shoes, clothes, eyeglasses, conveyance vehicles,

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vessels, and buildings). The panel focused on key concepts, such as user experience at the precarious balance between privacy and the "veillances" (purposeful sensing, including surveillance, sousveillance, dataveillance, and metaveillance).

XR

XR is "a form of extended intelligence and extended collective intelligence … [to] … help extend our sensory intelligence on land, in air, or in water … Unlike VR, which is typically a solo experience, XR is a shared experience…."[1] It is also an umbrella term to encompass VR, AR, MR, the metaverse, the IoT, and digital twins "as the unifying framework that not only interpolates across these diverse realities but also extrapolates (extends) beyond them to create entirely new possibilities. XR is the physical spatial metaverse, bridging the physical world, the virtual world of artificial intelligence, and the social world of human interaction."[2] (See Figure 1.)

XR also embodies XI[1] and is therefore sometimes written XR/XI or XIR (extended intelligent reality), stylized as XIR, XIR, or XIR.

THE PANEL

In the recent panel discussion on wearable computing and XR held at the ICCE 2025 Industry Program, industry experts explored the evolving landscape of technology and its integration into daily life. See Figure 2.

They emphasized the need for adaptable and flexible technological solutions that align with the dynamic demands of society and our environment. Central to the discussion was the role of storytelling in bridging connections between technology, people, and the planet, ultimately enhancing quality of life. The panelists advocated for the development of wearables and other technologies that not only focus on functionality but also promote socio–cyber-physical integration in a way that connects us to each other and to our surroundings. They underscored the need for a societal transformation that embraces technologies designed to foster connections between individuals and with their environments. The discussion concluded with a rallying call for participants to support a petition advocating for a future where technology serves to uplift humanity and the planet.

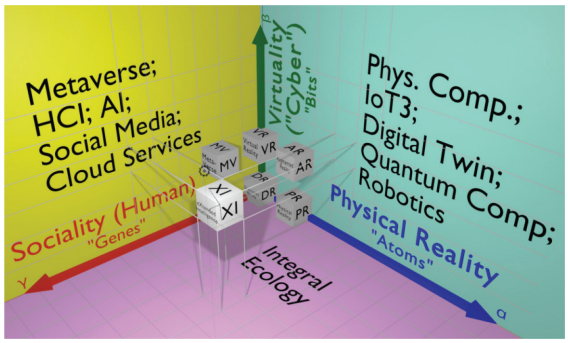

FIGURE 1. XR/XI is an umbrella term for VR, AR, Metaverse, Spatial Computing, IoT, etc., as well as a way to extend beyond these concepts. (Source: [2]; used with permission.)

FIGURE 2. Panel discussion at IEEE ICCE 2025. Left to right: Steve Mann, Bran Ferren, Tom Coughlin, and Bob Frankston, with panelist Marty Cooper presenting remotely.

Discussion Highlights

The six key highlights of the panel discussion were as follows:

1) *The Challenge of Information Overload*: The panel highlighted the difficulties of navigating a world filled with information, stressing the importance of self-awareness in recognizing one's own needs.
2) *Distinguishing Needs From Wants*: A key point discussed was the difference between wants and needs, with wants being described as the driving force behind innovation.
3) *The Need for Flexible Technology*: The experts stressed the necessity for technology that can adapt to the changing requirements of society, ensuring relevance and effectiveness.
4) *The Power of Storytelling*: Storytelling was emphasized as a vital tool for connecting technology with users, enhancing user experience and engagement.

5) *Wearables and Customization Challenges*: The panel addressed the complexities and benefits of wearables, discussing how customization can enhance user experience.
6) *Advancing Technology for Everyone and Earth*: There was a strong call to action for technology that serves humanity and supports ecological sustainability. The session concluded with a request for attendees to sign a petition advocating for a responsible and inclusive approach to technological development.

KEY INSIGHTS

The panel discussion arrived at several key insights, in alignment with the six key highlights:

1) *Understanding the Information Ecosystem*: The panelists articulated a critical issue concerning the overwhelming amount of information available through various channels. They compared society to a vast Internet where individuals act as search engines. This analogy underscores the challenge of discerning relevant information when individuals do not have a clear understanding of their own needs or the questions they should be asking. The experts advocated for educational initiatives that empower individuals to navigate their information environment more effectively.
2) *The Importance of Wants*: The discussion clarified the distinction between needs and wants, suggesting that while needs are often elusive and complex, wants are a clear motivator for innovation. Wants drive individuals to pursue new experiences and solutions, thus igniting creativity and prompting technological advancements. This perspective emphasizes the necessity of aligning technological development with human desires rather than solely focusing on addressing defined needs.
3) *Adapting Technology to Societal Changes*: The panelists stressed that technology must be flexible and adaptable to remain relevant in a rapidly changing society. As societal needs evolve, so too must the technologies that serve them. This insight calls for continuous innovation and reassessment of technological applications to ensure they meet emerging challenges and improve the quality of life for users.
4) *Storytelling as a Connection Tool*: The panel emphasized the role of storytelling in humanizing technology and fostering deeper connections between users and devices. By crafting narratives around technology, developers can create more engaging and relatable experiences for users. This approach can enhance user adoption and satisfaction, making technology feel less alien and more integrated into daily life.
5) *Challenges and Benefits of Wearables*: The discussion included an analysis of wearables, noting their potential to revolutionize personal health and fitness while also acknowledging the challenges of personalization and user engagement. Customization of wearables can lead to better user experiences; however, it also raises questions about privacy, data security, and the implications of constant connectivity. The panel encouraged a balanced approach to the design and implementation of wearables that prioritizes user needs and ethical considerations.
6) *Advancing Technology for People and Planet*: A recurring theme in the dialog was the vision for technology that not only serves human interests but also contributes positively to the planet. Panelists called for a shift in how we perceive and develop technology, advocating for solutions that enhance environmental sustainability and social responsibility. This vision calls for a holistic approach to technology that considers its broader impact on society and the environment.
7) *Call to Action for Collective Responsibility*: The concluding remarks of the panel highlighted the importance of collective action in shaping the future of technology. The call for attendees to join a petition illustrates the need for community involvement and advocacy in promoting responsible technological development. By rallying support, the panelists aim to create a unified voice that champions the advancement of technology for the benefit of all.

Following the panel discussion, participants were invited to an artistic intervention in the form of a series of photographic portraits by Steve Mann, titled "Lightbulb Moments Caught Red-Handed." See Figure 3.

The idea was to highlight technology as a mechanism to connect us to each other and to our environment, showing that we all share the same red color in the transmission of light, regardless of our skin color in reflection. While one holds onto a white light bulb, the skin transmits red because

FIGURE 3. Panelists and attendees in "Lightbulb Moments Caught Red-Handed."

of the hemoglobin in our blood. This highlights the red "Humanity" or "Sociality" axis of Figure 1. Planet Earth is blue (hence the blue "Physical Reality" axis), while humans are represented on the red axis, and technology is represented on the green axis, as suggested by the green glow of a cathode-ray oscilloscope or early computer screen technology, as shown in Figure 4.

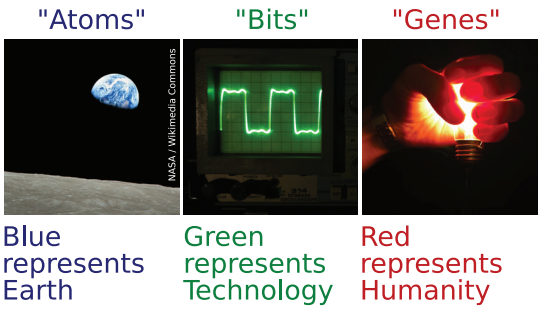

FIGURE 4. XR/XI is a physical–cybersocial construct. It has three main axes: 1) the physical world of "atoms," 2) the technological world of "bits," and 3) the social/human world of "genes." In this framework, we regard technology as a container or vessel that connects us to each other and to our surroundings.

CONCLUSION

In summary, the panel at ICCE 2025 offered a comprehensive overview of the current state and future direction of wearable computing and technology integration in society. The insights gained from the discussion underscore the necessity for flexibility, adaptability, and a human-centered and environment-centered approach in the development of new technologies. By recognizing the importance of wants alongside needs, leveraging storytelling, and embracing collective action, the panelists articulated a hopeful vision for a future in which technology serves both humanity and the planet.

We concluded with a suggested direction for the consumer technologies industry to make technology work for humanity and Earth. No longer can we or should we be imprisoned in an office or home or other building by technology that tethers us or fetters us to a desktop computer or the like. Technology should be designed so that it leaves us free to walk through the wilderness or go for a swim without having to worry about damaging it. Moreover, we call upon designers to embrace the idea of making technology that connects us to each other and our environment. This design philosophy extends beyond wearable technologies to include the broader class of "vironments." A *vironment* is the boundary between us (the "invironment") and our surroundings (the environment). Vironments include shoes, clothing, eyeglasses, bicycles, cars, cities, and waterfronts. Mersivity is about instilling respect between technology, each other, and the environment. Respectful technology is technology that is not imposed on others against their will, and it is designed in such a manner that it does not forbid us from direct access to the natural world. For example, we reserve rights, such as the right to safe access to water, e.g., the right to swim without being required to encapsulate ourselves in a boat or other vessel. More generally, we call upon designers of technology not to create an unfair or unreasonable dependence on a technology that would require people to adopt it against their will.

ACKNOWLEDGMENT

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