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Editorial: Augmented humans

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Editorial on the Research Topic
Augmented humans

Technologies augmenting intellectual and physical abilities have become commonplace in our modern world. The idea of augmenting human intellect has a long tradition: Bush (1945) described "Memex," a device extending the brain's information processing and memory capabilities by storing large chunks of information including books, communication, and any other records to augment human intellect. The vision of creating a human-machine symbiosis (Licklider, 1960) goes back to the 1960s when Engelbart (1962) presented the idea of augmenting human intellect using technologies. Today, many of the technologies envisioned by Engelbart and others are commonplace. Looking into the future, many technologies amplifying the human body and mind are within reach.

The Research Topic "*Augmented Humans*" connects researchers from interdisciplinary scientific areas, including ubiquitous computing, interface design, mixed reality, physiological sensing, and artificial intelligence. The collaboration between these research disciplines led to the foundation of the annual Augmented Humans conference. In this venue, professionals meet yearly to present recent advances in augmenting human intellect and physique through technologies. The result is a growing community moving forward the vision of Bush, Licklider, and Engelbart.

We received seven submissions, of which four articles were conditionally accepted. We accepted the four submissions after another round of reviews. We are happy to receive diverse scientific contributions regarding human augmentation, showing the fields' overall versatility. Taheri et al. presented how facial expressions can be used as controller input for users with motor impairment for video games. The presented study is an excellent example of how the vision of augmenting humans overcomes limitations due to physical or cognitive impairments. Genç et al. showed a categorization of human expression using appendages augmenting human appearance and skin by literature review. Looking at clothing as a design layer, the authors envisioned *in situ* augmentation with clothes and fabrics in the future. Miura et al. studied the body cognition of users who own multiple bodies in virtual environments. Specifically, the authors studied humans' task performance and body cognition when they have multiple entire bodies as an illustrative embodiment. They found that humans can have a sense of body ownership and agency for each body when controlling multiple bodies simultaneously. Finally, Nakamura et al. investigated how cheek stimulation can be

conducted for spatial directional guidance. With a technical prototype, the authors explored stimulation techniques using robot arms mounted on an HMD and found that cheek stimulation provides sufficient cues for guidance. A subsequent user study shows that cheek stimulation reduces task completion time for guidance tasks in virtual reality.

These articles present various approaches for human augmentation including implicitly integrated interaction with technologies. We are confident that the selected articles are both compelling and inspirational for all readers who wish to dive deeper into the domain of human-centered augmentation.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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