Augmenting Humans

Technology has long been used to augment our physical and cognitive abilities. Heavy machinery enables us to lift objects well beyond our strength, reading glasses correct and enhance our vision, and cameras capture memories for future recall. Wearable computing pioneered the integration of technology into our clothing and even our bodies, but ambient computing systems are also increasingly capable of supporting cognitive operations: a projected user interface, for example, can improve our sense of direction or ability to assemble a complex machine. Next-generation systems promise to augment our senses, voices, motor activities, and even our minds in unprecedented ways.

The vision of using computing technology to augment humans can be traced back to 1960, when J.C.R. Licklider published his seminal article “Man-Computer Symbiosis.” Wearable computers have been around since the 1980s, and for nearly three decades mobile and pervasive computing researchers have been exploring ways to augment humans, including via technology embedded in the infrastructure—for example, in projects such as the Georgia Tech Aware Home.

Seamlessly integrating this technology in our everyday lives, however, remains a challenge. How do we control on-body and in-body systems? How can augmented humans better tackle smart, IoT-enabled environments? What are the benefits and risks of these systems? In this special issue, we present three exciting articles that represent the state of the art in pervasive computing research into augmenting humans.

In the first article, “Wearable Assistive Technologies for Autism: Opportunities and Challenges,” Esma Mansouri Bessassi, Juan-Carlos Gomez, LouAnne E. Boyd, Gillian R. Hayes, and Juan Ye examine the use of pervasive computing technologies designed to assist those diagnosed with autism. The article briefly surveys existing wearable assistive technologies for autism and draws on the authors’ extensive experience in this field to highlight key opportunities and challenges for the research community.

The second article, “Learning from Our Mistakes: Identifying Opportunities for Technology Intervention against Everyday Cognitive,” Sarah Clinch and Cecilia Mascolo provide key insights into how pervasive technologies can help augment human memory. In particular, they describe a real-world study that captures memory failures. The study furthers understanding of this problem space and provides important insights that can help shape the design of future memory augmentation systems.

While our first two articles focus on cognitive augmentation, the third piece, “Robotic Symbionts: Interweaving Actions through Human and Machine Extensions” by Sang-won Leigh, Harshit Agrawal, and Pattie Maes, focuses on physical augmentation and in particular on how humans and robots can work collaboratively. Example applications of such collaborations are
likely to be found in future manufacturing, surgical, and domestic settings, and the authors illustrate the breadth of work that is required for pervasive computing to offer comprehensive implementation solutions.

These three articles are complemented by an in-depth interview with Pranav Mistry, Global Senior Vice President of Research at Samsung. Pranav describes his early work on human augmentation, the role of industry and academia in tackling emerging research challenges, and the importance of risk-taking and co-creation. Of special interest are his reflections on how the field has progressed over the past decade, and how this has differed from early predictions of human augmentation and technology.

We hope that you enjoy this special issue and that it serves to act as a catalyst for further pervasive computing research in the field of human augmentation—exciting work has been accomplished but much remains to be done.

REFERENCES


ABOUT THE GUEST EDITORS

Nigel Davies is a professor of computer science at Lancaster University. His research interests include systems support for mobile and pervasive computing. In particular, he focuses on the challenges of creating deployable mobile and ubiquitous computing systems that can be used and evaluated “in the wild.” Contact him at nigel@comp.lancs.ac.uk.

Marc Langheinrich is a professor in the Faculty of Informatics at Università della Svizzera Italiana (USI) in Lugano, Switzerland, where he heads the Research Group for Ubiquitous Computing. His main research interest lies at the intersection of privacy and ubiquitous computing. Langheinrich received his PhD in computer science from ETH Zürich. Contact him at langheinrich@ieee.org.

Pattie Maes is a professor and heads the Program in Media Arts and Sciences at the MIT Media Lab, where she also runs Fluid Interfaces group. In addition to her academic endeavors, Maes is an active entrepreneur and cofounder of several venture-backed companies. Coming from a background in artificial intelligence and human–computer interaction, she is particularly interested in the topic of cognitive augmentation, or how immersive and wearable systems can actively assist people with memory, learning, decision making, communication, and well-being. Maes received a PhD in artificial intelligence from the Vrije Universiteit Brussel. Contact her at pattie@media.mit.edu.

Jun Rekimoto is a professor in the Interfaculty Initiative in Information Studies at the University of Tokyo as well as deputy director of Sony Computer Science Laboratories. His research interests include human–computer interaction and integration, computer-augmented environments and human augmentation. Rekimoto received a PhD in information science from the Tokyo Institute of Technology. He is a member of the ACM SIGCHI Academy. Contact him at rekimoto@acm.org.