From the Editor in Chief

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Wearable Computing: Is It Just Hype?

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Body-worn and body-implanted computers have been a part of science fiction lore for many decades, most notably in Star Trek episodes. Recently, William Shatner (Star Trek's Captain Kirk) and Chip Walter published *Star Trek: I'm Working on That: A Trek from Science Fiction to Science Fact*. The book describes several Star Trek technologies that are now becoming reality—including wearable computing, which has grown from infancy to adolescence in the past decade (see the "In This Issue" sidebar for wearable computing articles).

Why would anyone want to wear a computer? Is it just to look cool, or do wearable computers offer genuine benefits unattainable through any other form factor? Experience over the past decade has shown that wearable computers can be especially valuable in situations where a mobile user is engaged in tasks such as vehicle maintenance, bridge inspection, or aircraft inspection. Thus, wearable computers have established their first foothold in such industrial applications, where hands-free computer operation provides a compelling advantage.

User comfort is a critical design consideration for success in these applications. The key to user comfort is creating small, lightweight, body-conforming designs with long battery life. Unfortunately, this typically means substantially sacrificing computing power. Consequently, a wearable computer typically has less memory, CPU speed, and disk capacity than a desktop or laptop of the same vintage.

This limitation in computing power makes *augmented reality* one of the most challenging yet intriguing uses of wearable computers. In AR, a user looks through a transparent heads-up display connected to a wearable computer. Any displayed image appears superimposed on the real-world scene before the user. AR thus creates the illusion that the real world is visually merged with a virtual world. This opens up a host of fascinating applications that border on science fiction. Imagine AR combined with image recognition. When you look at a person through magic glasses (that is, a heads-up display), his or her name could pop up in a balloon in case you didn't

IN THIS ISSUE

We are pleased to bring you this special issue on Wearable Computing Technologies and Applications. The first article, "Application Design for Wearable and Context-Aware Computers," by Asim Smailagic and Dan Siewiorek, offers a retrospective on a decade's work of creating application-driven wearable computers.

"The Evolution of Army Wearable Computers," by Matthew J. Zieniewicz, Douglas C. Johnson, Douglas C. Wong, and John D. Flatt, describes the US Army's experience in developing and using wearable computers for combat. Technical descriptions of military applications are rare, and although the authors suppress some technical details for security reasons, the article represents important documentation of early work in the field.

Chandra Narayanaswami and his team from IBM Research created a lot of excitement in 1999 and 2000 with their development of a wristwatch-form-factor computer capable of running Linux. Here, in "Designing a New Form Factor for Wearable Computing," Narayanaswami and M.T. Raghunath report on system development lessons they learned in the process.

"Wireless User Interface Components for Personal Area Networks," by Kenneth P. Fishkin, Kurt Partridge, and Saurav Chatterjee, describes several research directions in the area of wireless personal area networks, an important enabling technology for wearable computers.

"Creating Experiences with Wearable Computing," by Richard Hull, Josephine Reid, and Erik Geelhoed, describes the experience the authors gained from deploying wearable computer applications in the arts and entertainment domain.

"The Cloak of Invisibility: Challenges and Applications," by Franco Zambonelli and Marco Mamei, is a thought-provoking and exciting speculation on how sensor networks embedded in fabrics could be used to achieve invisibility. To offer a balanced perspective, we include two brief critiques from vision experts on the feasibility of the ideas in this article.

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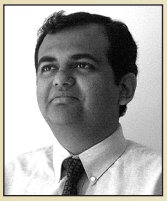
NEW EDITORIAL BOARD MEMBER



Please welcome Gaurav Sukhatme to *IEEE Pervasive Computing*'s editorial board. He is an assistant professor in the Computer Science Department at the University of Southern California. He also codirects the USC Robotics Research Laboratory, which performs research in the control and coordination of large numbers of distributed embedded systems and in the control of systems with complex dynamics (hopping robots, robotic helicopters, and haptic interfaces). His research interests include embedded systems, sensor networks, mobile-robot coordination and control, sensor fusion for robot fault tolerance, and human–robot interfaces. He received his MS and PhD in computer science from USC. He is a member of the AAAI, IEEE, and ACM. Contact him at Computer Science (MC 0781), Univ. of Southern California, 941 W. 37th Pl., Los Angeles, CA 90089-0781; gaurav@usc.edu; http://robotics.usc.edu/~gaurav.

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immediately recognize the person. Similarly, when you look at your thirsty houseplant, a "Water me" reminder could pop up, or a "Take me out" balloon could appear when you look at your long-suffering dog. Most important, when looking at your spouse, the balloon could say, "Don't forget, tomorrow is my birthday." Just imagine how valuable these magic glasses would be to politicians at fundraisers! I'm being facetious here, of course, but AR's potential for wearable computers is enormous.

However, superimposing the image of a virtual world on the real world requires a precise correspondence between the two worlds. As a user's orientation and location change, the displayed image must rapidly and accurately track those changes. Sluggish tracking can distract the user and, in extreme cases, result in symptoms similar to seasickness. At AR's heart lies a computationally intensive operation: 3D rendering. Even a user briefly turning his or her head can require re-rendering a complex scene multiple times. How do we reconcile AR's intense computational demands with the need for wearable computers to be small and light? This remains a difficult challenge.

AR is an immersive technology, and it is interesting to conjecture what Mark Weiser would have thought of it. AR did not exist at the time of his 1991 paper, "The Computer for the 21st Century," (*Scientific American*, Sept. 1991), but its close relative, virtual reality, had already been invented. Weiser viewed virtual reality as the antithesis of ubiquitous computing: "Perhaps most diametrically opposed to our vision is the notion of virtual reality, which attempts to make a world inside the computer…. Indeed, the opposition between the notion of virtual reality and ubiquitous, invisible computing is so strong that some of us use the term 'embodied virtuality' to refer to the process of drawing computers out of their electronic shells." Would Weiser have felt the same about AR? P