Digitally Enhanced Reality

Marc Langheinrich
Università della Svizzera Italiana (USI), Switzerland

Nigel Davies
Lancaster University, UK

Mark Billinghurst
University of Canterbury, New Zealand

The history of wearable computing reaches all the way back to the 1980s, with people like Steve Mann and Thad Starner using wearable devices to augment their senses and capture their everyday experiences.[1] However, recent developments have brought about a fundamental shift in the digital augmentation of reality. In the near future, it will be feasible to continuously record a plethora of personal experiences—what we see and hear and even our vital signals—and provide both in-situ and pre-emptive access to related information, past experiences, and social exchange. This might significantly change the way we interact with others, remember our past, and share our experiences.

Next-Generation Wearables

Google Glass has been at the forefront of much of the recent debate surrounding wearable computers. The ability to call up contextual information that will float in mid-air, without having to glance down into our now ubiquitous smartphones, has inspired not only a range of amazing new applications but also unleashed social backlash in the form of ridicule (see https://youtu.be/8UjcqCx1Bvg), exclusion (with some restaurants banning Glass[2]), and even violence.[3]

Glass is just one part of a new generation of wearable devices that challenge our perceptions of privacy. The Narrative Clip, for example, can be unobtrusively clipped onto a shirt lapel and will shoot a picture every 30 seconds for days on a single charge (see the related Interview department in this issue). The GoPro camera system will shoot 4k-resolution video for up to three hours and can be mounted on a plethora of gear, such as dashboards, bikes, or helmets. Neither the Clip nor GoPro seem to have received the same level of scrutiny as Glass, even though today's ski slopes teem with GoPro cameras.

Image capture is just a fraction of the types of data that can be recorded, but it's surely the most resource demanding and privacy contentious. Other life-logging devices typically capture only the activities of the wearer (as with the Fitbit) or owner (as with the app usage tracker). The challenge will be to make sense of all this data, going beyond a simple "collect and store" approach for some undefined query in the future. Instead, the goal will be to actively mine and correlate information to provide in-situ assistance (overlaying the names of people on a

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see-through display, for example) and in a pre-emptive fashion.

As part of the European research project, RECALL (http://recall-fet.eu), two of us (Nigel Davies and Marc Langheinrich) are involved in creating a system that uses captured images to help train human memory. The ability to successfully improve our memory hinges on making sense of the captured data, so we need to devise novel ways of mining and connecting captured experiences. Once such personal memory is "searchable," we can imagine connecting it to other people's memory. For example, the individual experiences of all those present at a meeting could be merged to allow for a much richer memory between all participants. This will not only be a problem of integrating the diverse systems and data structures, but also pose significant challenges for guarding access and distribution of such data. Privacy and social acceptance will remain key issues in a digitally enhanced reality, well beyond the Google Glass controversy.

In This Issue

The wealth of challenges in this exciting new field is thus staggering. This special issue offers five pieces that explore just some of these issues: three research reports, an interview, and a Spotlight department.

In the first article, "Designing Wearable Personal Assistants for Surgeons: An Egocentric Approach," Shahram Jalaliniya and Thomas Pederson present work they have done in the context of wearable computing in a hospital setting. They argue that wearable computer designs must be egocentric instead of device-centric. Using an information flow model, they include unconscious cognitive processes in their design that should open up novel design opportunities for future wearable assistants.

The second article, "Making Regular Eyeglasses Smart," by Oliver Amft, Florian Wahl, Shoya Ishimaru, and Kai Kunze, focuses on a particular class of wearable assistants—smart eyeglasses. Using three case studies of systems they developed, they illustrate opportunities for application designs on such hardware, for example to quantify reading habits or monitor exposure to natural light.

Our third article is "Creating Tutorials with Web-Based Authoring and Heads-Up Capture," by Scott Carter, Pernilla Qvarfordt, Matthew Cooper, and Ville Mäkelä. The authors investigate the benefits of a head-mounted video recording device (such as Google Glass) over tripod-mounted cameras to author tutorials. In particular, for more involved instructions, such as furniture assembly, a first-person perspective as captured by a head-worn device can significantly reduce the capture effort.

Our next piece is an interview with Martin Källström, CEO and founder of Narrative Inc., a Sweden-based company that redefined the idea of the SenseCam. By putting image capture into a light and unobtrusive form factor and adding a social networking platform underneath, Narrative has shifted camera-based lifelogging from the medical and therapeutical domain into a lifestyle device.

Last but not least, Markus Funk and Albrecht Schmidt report on the industrial use of a projection-based augmented reality device. Their Spotlight department describes a cognitive assistance system they deployed successfully in both a sheltered work organization and a car manufacturer.

The inclusion of cognitive processes, the measurement of everyday life through head-worn devices, the use of such devices to communicate experiences to others, and the diffusion of life-logging technology into everyday life (both for work and recreation), represent only a small subset of the potential in this field. We hope that these articles introduce you to new challenges and ultimately stimulate novel ideas in this space—a space ripe with innovation and full of potential!

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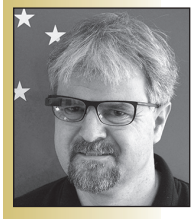
the AUTHORS

Marc Langheinrich is an associate professor in the Faculty of Informatics at the Università della Svizzera Italiana (USI), in Lugano, Switzerland, where he heads the Research Group for Ubiquitous Computing. Contact him at langheinrich@ieee.org.

Nigel Davies is a professor of computer science at Lancaster University. Contact him at nigel@comp.lancs.ac.uk.



Mark Billinghurst is a director of the Human Interface Technology Laboratory, New Zealand (HIT Lab NZ) at the University of Canterbury. Contact him at mark.billinghurst@hitlabnz.org.